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COVER: Soldiers with Battery A, 1st Battalion, 7th Field Artillery Regiment, manoeuvre an M109A6 Paladin howitzer at Grafenwoehr Training Area in Germany. (Photo: US Army)
ABOVE: French soldiers conduct a live-fire mission using a CAESAR self-propelled 155mm howitzer, part of Exercise *Dynamic Front 18*. (Photo: US Army)

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SPECIFICATIONS

SELF-PROPELLED HOWITZERS

This section provides a guide to self-propelled howitzers that are under development, in production or being substantially modernised.

The specifications listed here are intended to provide a handy reference source for the basic parameters that describe the weapon's performance. Most data has been supplied by the manufacturers, who can give more detailed information on request. Contact details are listed in the supplier guide.

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ABOVE: French soldiers conduct a live-fire mission using a CAESAR self-propelled 155mm howitzer in Grafenwoehr, Germany. (Photo: US Army)

AM General ▸ Hawkeye

AM General began marketing the Hawkeye 105mm Mobile Weapon System (105MWS) in 2016. The system mounts the soft-recoil Hawkeye 105mm Weapon System, developed by the Mandus Group, on an AM General 4x4 M1152Aw/B2 High Mobility Multipurpose Wheeled Vehicle. The Hawkeye uses the same 105mm/33cal M20 cannon – which is manufactured at Watervliet Arsenal – as the US Army's current M119 Light Gun mounted on a lightweight cradle. Four hydraulically operated stabilisers, two at the front and two at the rear of the vehicle, provide a stable firing platform. Powered traverse enables the weapon to move 90˚ left and right, with elevation from -5˚ to 72˚. In addition to direct and indirect optical sighting systems, the 105MWS is fitted with the MG9000 digital fire control and pointing system, which includes a Northrop Grumman LN-270 inertial navigation system, GPS, a Weibul Scientific muzzle velocity radar system and a Mandus gunner's display unit. The 105MWS can fire all types of 105mm ammunition now in US Army service, including the M1 and M760 high-explosive (HE), M60/M60A2 smoke, M193 HE rocket-assisted (RAP), M314 illumination and M1130A1 HE pre-formed fragmentation projectiles. The 105MWS is operated by a crew of four (although in extremis, this is possible with two personnel). A maximum rate of fire of up to 8 rounds per minute can be achieved. **Type:** lightweight 105mm SPH **Range:** 11,600m firing M1, 19,500m firing RAP **Crew:** 4 **Main armament:** 105mm/33cal **Turret – elevation:** -5/+72˚ **Rate of fire – main armament:** 8rpm max, 3rpm sustained **Turret – traverse:** 180˚; 360˚ possible if required

BAE Systems ▸ AS90

The AS90 155mm/39cal tracked SPH was designed and built by Vickers Shipbuilding and Engineering (acquired by BAE Systems in 1999) to meet the requirements of the British Army. Between 1992 and 1995, 179 weapons were delivered. The AS90 is equipped with an autonomous navigation and gun-laying system based on the vehicle's inertial navigation system. Fitted with an L31 39cal barrel, the AS90 can achieve a range of 24.7km firing a standard projectile. A desertised AS90, fitted with a 52cal barrel, is designated Braveheart. The turret of this model, mounted on a K9 Thunder chassis, was selected to meet a Polish Army requirement as the HSW Krab (see separate entry). Poland has since decided to use a German-built barrel with locally built Braveheart turrets. British Army AS90s underwent a capability enhancement programme in 2008-2009, and the UK government announced in October 2010 that the number of AS90s remaining in service would be reduced to 95 from 146. The army had wanted to modernise the AS90 with 155mm/52cal barrels and introduce the Extended-Range Ordnance/Modular Charge System, but this effort was cancelled because of a lack of funds. The Raytheon Excalibur 155mm precision-guided munition has been successfully fired from the AS90 but the UK has not yet ordered it. **Type:** tracked 155mm/39cal SPH **Length:** 9m **Width:** 3.3m **Height:** 3m **Weight:** 45t **Ground clearance:** 410mm **Max speed:** 55km/h on road **Range:** 370km on road **Gradient:** 60% **Side slope:** 25% **Fording:** 1.5m without preparation **Trench:** 2.8m **Secondary weapon:** 1x roof-mounted 7.62mm MG **Powerplant:** Cummins VTA903T V8 4-stroke, liquid-cooled turbodiesel **Crew:** 5 **Main armament:** L31 155mm/39cal **Barrel elevation:** -5/+70˚ **Ammunition carried:** 48x 155mm projectiles and charges, 1,000x 7.62mm rounds **Range – main armament:** 25km (39cal), 30km (52cal) with standard charges **Rate of fire – main armament:** 3 rounds in 10s (burst), 6rpm for 3min (intense), 2rpm for 60min (sustained)

BAE Systems Bofors ▸ FH77 BW L52 Archer

The FH77 BW L52 Archer is a 155mm/L52 wheeled SPH, based on the towed FH77 B, developed to meet the requirements of the Swedish Army. In 2003, Sweden's FMV defence procurement agency awarded a development contract to Bofors (now BAE Systems) to build two demonstrator howitzers. Sweden and Norway signed a cooperative agreement in November 2008 for development of the system, and in March 2010 BAE Systems received a contract to build 24 weapons for Norway and 24 for Sweden. The system mounts a fully automated howitzer on a modified Volvo A30D 6x6 articulated chassis. A crew of three or four operates the weapon from within the protection of an armoured cab. The Archer carries 40 rounds, of which 20 are in a fully automated magazine and can achieve a range of 60km with the M982 Excalibur guided munition. The system can be carried inside an A400M transport aircraft. On 23 September 2013, Sweden received the first of four pre-series production weapons. In December 2013, Norway cancelled its Archer buy and confirmed that its remaining M109A3GN weapons will remain in service until 2020. By June 2016, Sweden had received six pre-qualification systems (which will be returned to the manufacturer for upgrade to full production standard) and ten production-standard weapons, with the remaining eight scheduled for delivery by the end of 2016. On 20 September 2016, the Swedish government stated that it would fund the production of the 24 weapons originally intended for Norway, retaining 12 in Swedish service and offering the remaining 12 for export. **Type:** 6x6 wheeled 155mm/52cal SPH **Length:** 14.1m **Width:** 3m **Height:** 3.3-3.9m **Weight:** 30t **Max speed:** 70km/h on road **Range:** 500km on road **Crew:** 4 **Main armament:** 155mm/L52 **Ammunition carried:** 40 rounds **Rate of fire – main armament:** 3 rounds in 15s salvo, full magazine of 20 rounds in 2.5min (intensive rate); up to 6 MRSI **Range – main armament:** 30km with standard shells, 40km with base-bleed, 60km with M982 Excalibur

BAE Systems Bofors ▸ FH77 L52 MGS

The FH77 L52 Mounted Gun System (MGS) combines the towed 155mm FH77 B gun, upgraded to 52cal, with the mobility of the Archer SPH. Like the Archer, the crew rides in a ballistic and NBC-protected cabin mounted on a modified Volvo A30D 6x6 articulated chassis, although they dismount to operate the gun. Designed to appeal to customers that operate the FH77 B, such as the Indian Army, consideration has been given to simplifying and optimising handling of the gun system, says the company. Most ammunition handling and all ammunition loading procedures are mechanically assisted and semi-automated. An initial burst of three rounds can be fired within 20 seconds and 15 rounds can be fired within three minutes. The MGS can be brought into and out of action in less than a minute. The gun computer system allows an MRSI of six rounds to be achieved. **Type:** 6x6 wheeled 155mm/52cal SPH **Length:** 14.1m **Width:** 2.9m **Max speed:** 70km/h on road **Range:** 500km **Crew:** 3-5 **Main armament:** 155mm/L52 **Rate of fire – main armament:** 3 rounds in 20s (burst), 15 rounds in 3min (intensive), 75 rounds an hour (sustained) **Ammunition carried:** 24 rounds **Range – main armament:** 40km (HEER 40), 50km (M982 Excalibur)

BAE Systems Inc ▸ M109

The M109 155mm tracked SPH was developed from 1952-61 to meet US Army requirements. The original M109, equipped with an M126 155mm/23cal cannon, entered service in 1963 and was followed by the M109A1 model, equipped with the longer-range M185 155mm/39cal cannon, from 1973. US Army M109s have undergone numerous upgrades, and 957 M109A6 Paladins have been delivered since 1992. The newest US Army variant is the M109A7 (see separate entry). The M109 features a fully enclosed turret mounted on the rear of a tracked chassis. It has a crew of six, consisting of the commander, driver, gunner, assistant gunner and two ammunition handlers. The M109A6 Paladin features numerous improvements, including a new turret, which reduces the crew to four (commander, driver, gunner and an ammunition loader). New or second-hand M109s were sold to 38 countries, including South Korea which built 1,040 weapons locally, and the M109 became the most widely employed SPH by NATO members. The M109 has been phased out of service by Belgium, Canada, Germany, the Netherlands and the UK. Several companies in Germany, Israel, the Netherlands, Switzerland and other countries have developed upgrade packages to meet national requirements. In 2016, the Norwegian Army shortlisted the Ruag M109 Krait upgrade for the competition to replace the service's M109A3GNs. On 27 April 2017, Latvia signed an agreement with Austria to acquire 47 howitzers which were upgraded to the M109A5Oe configuration from 2003-07. In June 2017, the Brazilian Army received the first of 36 ex-US Army M109s being upgraded by BAE Systems to the M109A5+BR standard. **Type:** tracked 155mm/39cal SPH **Length:** 9.1m **Width:** 3.15m **Height:** 3.25m **Weight:** 27.5t **Max speed:** 56km/h on roads **Range:** 350km on roads **Secondary weapon:** .50cal HMG or 7.62mm MMG **Powerplant:** Detroit Diesel 8V71T diesel **Crew:** 6 **Main armament:** M126 155mm/39cal **Turret – traverse:** 360° **Barrel elevation:** -3/+75° **Rate of fire – main armament:** 4rpm maximum, 1rpm sustained **Range – main armament:** 18km standard, 30km RAP

BAE Systems Inc ▸ M109A7

The M109A7, previously known as the M109A6 Paladin Integrated Management programme, is a semi-automated, 155mm/39cal artillery system designed to support the US Army's armoured brigade combat teams (ABCTs) until 2050. The service upgraded 975 older M109s to the 155mm/39cal M109A6 Paladin configuration and plans to upgrade 580 to the M109A7 standard. The Paladin is the primary indirect fire support system for ABCTs, and the M109A7 is supported by the army as a vital technology enhancement programme to maintain combat capability. The M109A7 is intended to meet the long-term readiness and modernisation needs of the M109 family of vehicles, which includes the M992 Field Artillery Ammunition Support Vehicle, through a redesign and production plan to provide a more robust, survivable and responsive indirect fire support capability. The M109A7 uses the existing M284 155mm/39cal main armament and recently designed cab structure, while replacing outmoded chassis components with automotive, drive train and suspension components from the Bradley Combat Systems programme to increase sustainability and commonality across ABCTs. The programme is executed as a public/private partnership between the army's Project Manager ABCT, Anniston Army Depot and BAE Systems. In October 2013, the army awarded the first low-rate initial-production (LRIP) contract for 19 M109A7s and 18 M992A3 Carrier Ammunition Tracked vehicles. The first system was delivered on 13 April 2015. In October 2014, the army placed a $141.8 million fixed-price LRIP Option 1 contract for 18 sets, each consisting of an M109A7 and an M992A3. In October 2015, BAE Systems received the second LRIP option worth $245.3 million for 30 sets. By 30 June 2017, the company had delivered 36 sets plus one additional

howitzer. In December 2017, the army exercised the $413.7 million third and final LRIP option to provide 48 sets. The contract includes options for full-rate production of 60 sets annually over a three-year period, which would bring the total value to approximately $1.7 billion. **Type:** tracked 155mm/39cal SPH **Length:** 9.7m **Width:** 3.9m **Height:** 3m **Weight:** 31.7t **Ground clearance:** 400mm **Max speed:** 61km/h on road **Range:** 300km **Powerplant:** 447kW Cummins diesel **Crew:** 6 **Main armament:** M284 155mm/39cal **Rate of fire – main armament:** 4rpm **Range – main armament:** 24km (standard); 30km (rocket-assisted); 40km (M982 Excalibur)

CIO Consorzio Iveco-Oto Melara ▸ Centauro 155/39

The Centauro 155/39 artillery system is being developed by CIO to meet the Italian Army's requirement for an ultra-lightweight self-propelled wheeled howitzer to equip the medium brigades which operate the Centauro tank destroyer, Freccia IFV and other wheeled vehicles. The prototype was displayed at Eurosatory 2012 and firing trials began in 2013. The system mounts a fully automated turret on an 8x8 Centauro chassis. According to Leonardo, when firing the company's Vulcano extended-range ammunition, developed for naval and land applications, the Centauro 155/39 can achieve a maximum range of 60km. The 155mm/39cal weapon is loaded by remote control, reducing the vehicle's crew to three – commander, gunner and driver. The Centauro 155/39 is ready to fire within three minutes of coming to a halt and is ready to move within one minute of completing a fire mission. **Type:** 8x8 wheeled 155mm/29cal SPH **Weight:** 30t **Max speed:** 110km/h on road **Range:** 800km on road **Gradient:** 60% **Trench:** 1.4m **Crew:** 3 **Main armament:** 155mm/39cal **Range – main armament:** 60km (Vulcano) **Rate of fire – main armament:** 8rpm; MRSI up to 4

SPECIFICATIONS

TOWED HOWITZERS

This section provides a guide to towed howitzers that are under development, in production or being substantially modernised.

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ABOVE: A CH-47 Chinook helicopter lifts off carrying an M777 howitzer during sling-load training on a range at Fort Campbell on the Kentucky-Tennessee border. (Photo: US Army)

BAE Systems ▸ M119

The M119 is a variant of the BAE Systems L119 105mm Light Gun developed and built for the US Army to replace the M101A2 and M102 105mm howitzers, and equip its light divisions. BAE Systems and the US government-owned Rock Island Arsenal began production of the M119 in 1987 and the first unit was equipped in December 1989. The M119 was used extensively in Afghanistan and Iraq, and production of the improved M119A2 was resumed in 2007. More than 800 M119s have been produced for the US Army with additional howitzers built for US FMS customers including Morocco and Saudi Arabia. The M119 fires standard US M1 105mm ammunition. Improvements to the M119 include a cold-weather recuperator, enabling operation down to -45°C with reduced maintenance, a more robust sight and brake modifications to facilitate towing behind an AM General High Mobility Multipurpose Wheeled Vehicle. The US Army is upgrading its M119A2s to the M119A3 standard, which includes a GPS-aided INU. About 90% of the software for the package was taken from the US Army's BAE Systems 155mm M777A2 howitzer. The upgrade also includes a new recoil system designed to make the howitzer safer, simpler and more reliable, while also reducing the cost of the system. In 2017, Watervliet Arsenal announced the development of a 105mm Low Blast Overpressure Muzzle Brake for the M119, which reduces blast overpressure between 13-48°. **Width:** 1.78m **Height:** 1.37m in travelling configuration **Deployed length:** 4.87m **Weight:** 1,860kg **Calibre:** 105mm **Distance range:** 11.6km unassisted, 19.5km assisted **Traverse:** 360°

BAE Systems Bofors ▸ FH-77B

The 155mm/39cal FH-77B is an export model of the FH-77A, which BAE Systems (then Bofors) developed and built for the Swedish Army from 1978-1984. The most significant difference between the two weapons is the FH-77B's ability to fire NATO 155mm ammunition. To reduce crew fatigue and boost the rate of fire, the weapon is fitted with an automated loading system. The FH-77B can achieve a range of 24km with standard ammunition and 30km firing base-bleed. A typical 6x6 prime mover is able to tow the FH-77B at up to 70km/h on roads, while an APU enables it to move at up to 8km/h. BAE Systems upgraded the FH-77B to the FH-77 BO5 L52 configuration with a 155mm/52cal ordnance, which extends the range beyond 41km, as well as introducing numerous other improvements, including a new FCS. The FH-77 BO5 L52 has been evaluated in India several times to meet an army requirement for 400 155mm/52cal towed weapons. The company produced 48 FH-77Bs for Nigeria, 51 for the Swedish Army and 410 for India, which were delivered by 1990. India's original plan to produce the FH-77B locally was cancelled. In October 2012, the country's Ordnance Factory Board was contracted to upgrade 144 FH-77Bs to 155mm/45cal configuration, designated the Dhanush, and the project is expected to increase to cover 400 weapons. **Width:** 2.65m travelling, 7.18m firing **Height:** 2.82m travelling **Barrel length:** 11.6m travelling, 11.6m firing **Weight:** 12t **Calibre:** 155mm/39cal **Distance range:** 24km standard, 30km BB **Crew:** 6 **Rate of fire:** 10rpm rapid

BAE Systems Platforms & Services ▸ 105mm Light Gun

The 105mm Light Gun was designed and manufactured by Royal Ordnance Nottingham (now BAE Systems), with the first guns introduced to the British Army in 1974. By changing the barrel, the Light Gun could be supplied in L118 configuration to fire British ammunition or in L119 configuration, which fires US 105mm M1 ammunition. Over 1,600 weapons were produced for customers in 19 countries, including Australia (under the local designation Hamel), Bahrain, Botswana, Brazil, Ireland, Kenya, Malawi, Morocco, New Zealand (Hamel), Oman, Portugal, Spain, the UAE, the UK and the US Army, which acquired 804 modified L119s under the designation M119 (see separate entry). The weapon was first used in combat during the 1982 Falklands War and it has seen extensive combat service with British and US forces in Afghanistan and Iraq. Improvements to the British Army's L118s include fitting the Selex Laser INertial Automatic Pointing System from 1999 and the Selex Layers Display and Control Unit from 2011. With the closure of the RO Nottingham plant, production and support activities were transferred to the BAE Systems Weapon Systems site at Barrow-in-Furness. BAE Systems bought 92 Hamels from Australia when the army replaced its Hamel guns with the BAE Systems M777 155mm howitzer (see separate entry) and is refurbishing these weapons to offer them to customers. At Eurosatory 2016, company officials predicted the guns will interest armies in Latin America and the Middle East seeking a proven, cost-effective artillery system. **Width:** 1.78m **Height:** 1.37m travelling **Barrel length:** 6.63m travelling, 7.01m firing **Weight:** 1.86t **Ground clearance:** 500mm **Calibre:** 105mm **Distance range:** 17.4km, 21km assisted (L118); 11.6k, 19.5km assisted (L119) **Rate of fire:** 18rpm burst, 3rpm sustained

BAE Systems Platforms & Services ▸ M777

The Ultralightweight Field Howitzer (UFH), now designated M777, was designed in 1987 in order to satisfy US Army requirements for a lightweight 155mm howitzer. The M777 was the world's first artillery system to incorporate large-scale use of titanium and aluminium alloys, reducing weight to less than 4.2t. It was selected in 1997 by the USMC (580 have been bought) and the US Army (421) to replace the 7.3t M198 howitzer. The latest US standard is the M777A2, which is equipped with the Digital Fire Control System. A number of initiatives are being pursued by BAE Systems to further improve the performance of M777. These include a Hydraulic Power Assist Kit to speed up operation and reduce potential crew fatigue, and an Improved Power Conditioning Control Module to improve temperature and reliability. In 2005, Canada became the first export customer when it ordered the first of 35 M777A1s equipped with the Leonardo Laser Inertial Navigation Artillery Pointing Systems for service in Afghanistan, and since 2008 Australia has bought 54 M777A2s. In 2011, Saudi Arabia ordered 36 M777A2s through the US FMS programme. In 2016, the US Army's Armament Research, Development and Engineering Center fitted a 155mm/55cal barrel on an M777 as part of the Extended Range Cannon Artillery project, which seeks to increase range of US 155mm artillery. In November 2016, the M777ER successfully fired 70 rounds in the first phase of trials. In May 2016, BAE Systems announced that it was working with Emirates Defense Technology (EDT) to develop a self-propelled version of the M777 for the UAE Armed Forces, to be mounted on an EDT Enigma 8x8 AFV chassis. On 24 June 2016, India's Defence Acquisition Council approved the long-discussed purchase of 145 M777s through the US FMS process. The first 25 weapons will be supplied assembled with the remaining 120 howitzers produced locally by BAE Systems in partnership with Mahindra Defence. On 12 January 2017, BAE Systems announced that it had received a $542 million FMS contract to provide 145 M777s. The first two weapons were delivered on 18 May 2017 and will be followed by another three in September to assist with the development of training. Serial deliveries with begin in late 2018. **Width:** 2.59m towed, 4.34m firing **Height:** 2.69m towed, 2.01m firing **Barrel length:** 9.73m towed, 10.48m firing **Weight:** 4.22t **Calibre:** 155mm/39cal **Distance range:** >30km assisted (M549A1 rocket on/M203A1), >24.6km unassisted (M549A1 rocket off/M203A1) **Crew:** 7 **Rate of fire:** 4rpm for 2min, 2rpm sustained **In out of action time:** <3min, <2min

SPECIFICATIONS

SELF-PROPELLED MORTARS

This section provides a guide to self-propelled mortars that are under development, in production or being substantially modernised.

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Soldiers from 1st Battalion, 8th Infantry Regiment, 3rd Armored Combat Brigade Team, conduct mortar fire from an M1064 mortar carrier at Range Joanna, Poland in January 2017. (Photo: US Army)

BAE Systems Hägglunds AB ▸ Mjölner

In December 2016, BAE Systems Hägglunds received a $68 million contract from the Swedish Defence Materiel Administration (FMV) to supply 40 Mjölner twin-barrel mortar systems mounted on Swedish Army tracked CV90 vehicles. The Swedish Army originally intended to acquire the 120mm AMOS (see separate entry), developed by BAE Systems Hägglunds and Patria Land Systems, to replace the towed mortars now used by its mechanised infantry battalions and ordered 40 new CV90 hulls for the project. In 2008, Sweden cancelled plans to buy the AMOS because of budgetary restrictions and the hulls have since been in storage. Neither BAE Systems nor the FMV revealed technical details of the Mjölner system when the contract was announced. Deliveries are scheduled to begin in Q1 of 2019. **Type:** twin-barrel 120mm vehicle-mounted mortar

BAE Systems Platforms & Services ▸ M1064 120mm Mortar Carrier

The BAE Systems M1064 is the standard 120mm self-propelled mortar in service with US Army armoured brigade combat teams. The system consists of an Elbit-designed Soltam M121 120mm smoothbore mortar mounted in the rear of a BAE Systems M113A3 APC. The mortar is fired through an open hatch and can be traversed through a 90° arc. The US Army has upgraded its M1064A2s to the current M1064A3 standard. In US Army service, the M1064 was to have been replaced by the 120mm Non-Line-of-Sight Mortar until the Future Combat Systems project was cancelled in 2009. In December 2014, the US Army selected BAE Systems to develop the tracked Armoured Multi-purpose Vehicle family based on the M2 Bradley. This will include a mortar carrier to replace the M1064A3. BAE Systems is expected to remove the mortars from the M1064A3 and mount them in the new-build vehicles. In November 2016, Elbit Systems of America and the US Army signed an indefinite-delivery/indefinite-quantity contract worth up to $103 million for production of the M224 and M224A1 60mm lightweight company mortars, the M252 and M252A1 81mm mortar, the M121 120mm carrier-mounted mortar, and the M120A1 120mm towed mortar systems. The US has supplied the M1064A3 mortar carrier to Israel for use with the Elbit Soltam CARDOM mortar and exported complete systems to Thailand. **Type:** tracked 120mm SP mortar **Length:** 5.3m **Width:** 2.69m **Height:** 1.85m to top of hull **Weight:** 12.8t combat ready **Ground clearance:** 430mm **Max speed:** 66km/h on road **Distance range:** 483km **Gradient:** 60% **Side slope:** 40% **Trench:** 1.66m **Secondary weapon:** pintle-mounted M2HB .50cal HMG **Powerplant:** 275hp Detroit Diesel 6V-53T **Crew:** 6 **Main armament:** 120mm smoothbore mortar **Ammunition carried:** 69x mortar bombs, 2,000x .50cal rounds **Range – main armament:** 7.24km (M933) **Rate of fire – main armament:** 15rpm max, 4rpm sustained

Elbit Systems Land and C4I ▸ Soltam 120/81mm CARDOM

The Soltam 120mm Computerised Autonomous Recoil Deployed Outrange Mortar (CARDOM) is in service with the IDF (mounted in the tracked BAE Systems M113A3 (~250 systems)), the US Army (~450 M121 systems mounted in tracked M1064 and 8x8 Stryker M1129 mortar carriers) and other customers in many countries reaching ~1,000 systems worldwide. The CARDOM is a fully automated electrical system which is delivered with an FCS, BMS and INS for navigation and autolay. It has an open architecture, allowing integration with legacy BMS or various INS. The CARDOM can be installed and integrated on different platforms and APCs with its 360° turntable bearing and soft recoil mechanism, it uses a 120mm smoothbore barrel but can integrate barrels with different lengths and thicknesses. The CARDOM can fire all NATO-standard 120mm mortar ammunition. The crew can replace the 120mm barrel with an 81mm barrel. In November 2016, Elbit Systems of America and the US Army signed an indefinite-delivery/indefinite-quantity contract worth up to $103 million for production of the M224 and M224A1 60mm lightweight company mortars, the M252 and M252A1 81mm mortar, the M121 120mm carrier-mounted mortar and the M120A1 120mm towed mortar systems. **Type:** turntable-mounted 120mm mortar **Weight:** 670kg (weapon system) **Distance range:** 7.2km (standard), 9.5km (extended-range) **Main armament:** 120mm smoothbore mortar **Turret – traverse:** 360° in most applications **Rate of fire – main armament:** 15rpm max

Elbit Systems Land and C4I ▸ Soltam Spear MK II

Elbit Systems publicly unveiled the Soltam Spear MK II 120mm recoil mortar system at Defexpo 2016. It is a second-generation development of the Soltam Spear unveiled at Eurosatory 2014. The Spear features a soft recoil system that reduces the force to 10-15t compared with the 30t recoil force of the CARDOM (see separate entry), enabling it to be mounted on lightweight 4x4 army vehicles such as the HMMWV, VAMTAC and others. Like the CARDOM, it is equipped with FCS, BMS and INS for navigation and autolay into the firing position, which allow autonomous operation and provide increased firepower and accuracy. Targeting information is transmitted via the C4I network to the FCS, which computes the ballistic data and positions the mortar barrel to the correct azimuth and elevation at the 'push of a button'. Spear MK II is compatible with all types of 120mm smoothbore mortar munitions. A crew of two to three can deploy in less than a minute and fire a burst of up to 16 rounds in the first minute. **Type:** 120mm mortar for light vehicles **Crew:** 2-3 **Rate of fire – main armament:** 15rpm burst rate, 4rpm sustained

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TOWED MORTARS

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ABOVE: A USMC sergeant fires an M327 mortar during a live-fire training event at Camp Lejeune, North Carolina. (Photo: USMC)

Elbit Systems ▸ Soltam A7A2 120mm Mortar

The A7A2 is the latest version of the Soltam 120mm long-range mortar series. Soltam 120mm mortars are in service in more than 20 countries. The carriage of the Soltam A7A2 is integrated into the bipod. Although the wheels remain attached to the bipod in the firing position, the mortar does not rest on them. The smoothbore A7A2 fires all conventional 120mm mortar rounds. It is typically operated by a crew of four or five. **Length:** 2.9m travelling **Width:** 1.6m travelling **Barrel length:** 2.1m **Weight:** 420kg in firing mode **Calibre:** 120mm **Rate of fire:** 13rpm **Elevating range:** 40-85°

Elbit Systems ▸ Soltam K6 120mm Lightweight Towed Mortar

The Soltam K6 120mm Lightweight Towed Mortar has a maximum range of 7.2km using conventional unassisted bombs. The K6 was selected for US Army service in 1990 as the M120/121 Battalion Mortar System. Soltam 120mm mortars are in service in more than 20 countries. The K6 mortar is a smooth-bore, muzzle-loaded weapon with a traverse angle of 360°. A carriage, which includes six ammunition canisters accommodating six ready-to-fire bombs, two compartments for general equipment, as well as a compartment for two aiming posts, holds the assembled mortar. The mortar consists of a barrel, 'A'-type bipod and baseplate. The barrel is equipped with fixed/retractable firing pin. A standard crew of four can bring the K6 into action in about one minute. The US Army is now fielding the M191A bipod with the M120/121, which is 35% lighter than the 91kg M191 bipod that it replaces. In November 2016, Elbit Systems of America and the US Army signed an indefinite-delivery/indefinite-quantity contract worth up to $103 million for production of the M224 and M224A1 60mm lightweight company mortars, M252 and M252A1 81mm mortars, M121 120mm carrier-mounted mortar and M120A1 120mm towed mortar system. **Length:** 2.5m travelling **Width:** 1.56m travelling **Barrel length:** 1.8m **Weight:** 147kg ready to fire, 327kg on travel carriage **Calibre:** 120mm **Effective range:** 180-7,200m **Rate of fire:** 16rpm **Elevating range:** 40-85°

EXPAL ▸ 120mm MX Mortar Series

The 120mm MX Mortar Series consists of two models with different barrel lengths: the 1.6m 120MX1 and 1.8m 120MX2. The design has numerous improvements based on recent operational experience. The 120mm MX series can be transported on a towed carriage designed for movement in rough terrain. Both mortars can be prepared for firing in one minute and ready to move in 45s. The mortar is operated by a crew of four. **Barrel length:** 1.6m (120MX1); 1.8m (120MX2) **Weight:** 148kg (120MX1); 156kg (120MX2); 188kg (carriage with tools) **Calibre:** 120mm **Effective range:** 8,000m (120MX1); 8,300m (120MX2)

General Dynamics Ordnance and Tactical Systems ▸ M120 120mm Towed Mortar System

The M120 120mm Towed Mortar System is a US-built version of the Soltam K6 mortar (see separate entry) that was accepted into US Army service in 1990. The M120 is transported in an M1101 trailer towed by an HMMWV and since 2009 emplaced and displaced using the M326 Mortar Stowage Kit developed by BAE Systems. Crews are equipped with the M150/M151 Mortar Fire Control System-Dismounted, which combines an FCS with INS and pointing systems, allowing fire to begin in less than one minute. The M120 is operated by a crew of five. As well as standard ammunition, the M120 can fire the XM395 Precision-Guided Mortar Munition, developed by ATK to meet a US Army requirement, which made its combat debut in Afghanistan in March 2011. **Barrel length:** 1.8m **Weight:** 145kg **Calibre:** 120mm **Rate of fire:** 15rpm for first 1min, 4-5rpm sustained **Feed mechanism:** drop-fed **Maximum range:** 7,200m

Hirtenberger Defence Systems ▸ M12 120mm Mortar

Hirtenberger developed the M12 in collaboration with the Austrian Army. It has been in service with the country since 1985.The M12 is available in two barrel lengths. The weapon can be transported on a towed carriage for dismounted use or integrated in a tracked armoured vehicle. The design of the carriage enables the mortar to be deployed ready to fire within 45s. The bipod carries the barrel clamp, shock absorbers, damper rings, traversing, elevating and cross-levelling gears and the bipod legs with spikes and cross struts. The baseplate is made of welded steel and has six ribs and vents. Specifications for M12-1385/M12-1535. **Width:** 1,780mm carriage **Barrel length:** 1,750mm/1,900mm **Weight:** 260kg/265kg firing position; 700kg with trailer **Calibre:** 120mm **Rate of fire:** 15rpm **Length of carriage:** 3,700mm **Ballistic length:** 1,385mm/1,535mm **Maximum range:** 8,800m/9,100m

Motovilikhinskiye zavody ▸ 2B11 Sani

The 2B11 Sani 120mm smoothbore mortar, which entered Soviet Army service in 1981, is based on the M-43 with various improvements to reduce weight. Whereas the M-43 weighed 280kg in firing configuration and achieved a maximum range of 5,700kg, the 2B11 weighs 210kg and can achieve a 7,180m range using a long-range charge. The 2S12 is the designation for the complete mortar system consisting of the 2B11 and its GA-66 transport vehicle, which carries the mortar, 48 rounds, the five-strong mortar crew and a vehicle crew of one or two. As well as Russia, the 2B11 is also in service in Algeria, Azerbaijan, Belarus, Kazakhstan, Tajikistan and Ukraine. Some customers mount the 2B11 in the Soviet-designed MT-LB tracked carrier firing through an open hatch: Belarus (designated SM120); Bulgaria (SMM 74 B1.10 Tundzha-Sani); and Kazakhstan (Aybat). **Weight:** 297kg travelling, 210kg firing **Calibre:** 120mm **Effective range:** 460-7,180m **Rate of fire:** 12-15rpm **Muzzle velocity:** 325m/s **Elevating range:** 45-80° **Sights:** MPM-44M **Feed mechanism:** drop-fed

SPECIFICATIONS

SELF-PROPELLED ROCKET LAUNCHERS

This section provides a guide to self-propelled rocket launchers that are under development, in production or being substantially modernised.

The specifications listed here are intended to provide a handy reference source for the basic parameters that describe the weapon's performance. Most data has been supplied by the manufacturers, who can give more detailed information on request. Contact details are listed in the supplier guide.

Entries are listed alphabetically by company.

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ABOVE: US marines head to the firing point to launch the High Mobility Artillery Rocket System during Operation *Steel Knight*, conducted at Twentynine Palms, California, in December 2017. (Photo: USMC)

Arnold Defense ▸ Fletcher

Arnold Defense, which has produced more than 1.1 million 2.75in/70mm rocket launchers for airborne applications since 1961, unveiled the Fletcher 2.75in/70mm Weapon System at the DSEI exhibition in September 2017. After discussing the concept for several years with potential customers, such as the US Army and the USMC, the company teamed with BAE Systems, Nammo, Military Systems Group and Supacat in early 2017 to develop the concept demonstrator. Although the system is initially being developed for integration on vehicles, Arnold Defense is also considering mounting the launcher on naval and littoral platforms. At DSEI, the launcher was displayed integrated on a Supacat 6x6 HMT 600 (see separate entry). The smart four-round launcher is integrated on a universal gun mount developed by Military Systems Group. The launcher can be dismounted from the vehicle and mounted on a tripod. The smart launcher relays target data from a laser designator to the 2.75in Hydra 70 rocket equipped with an Advanced Precision Kill Weapon System semi-active laser guidance component and a Nammo M282A1 warhead. The rockets can accurately engage targets at ranges up to 6.5km. Arnold Defense is discussing with Nammo replacing the present Mk 66 MOD 4 rocket motor with a new unit which could extend the range to 12km. The company is also discussing with Rockwell Collins, which supplies the Fletcher's laser rangefinder and human-machine interface, the integration of technology, including GPS guidance, to give the rocket an indirect fire capability. Arnold Defense believes the lightweight system is well suited for special operations, light and rapid reaction forces which need a precision weapon system mounted on a lightweight platform. The Fletcher system is expected to be available for delivery in late 2018. **Type:** 2.75in/70mm launcher for vehicle integration

Length: 2.0m for launcher **Width:** 300mm for launcher **Height:** 300mm for launcher **Weight:** 13.6kg unloaded, 59kg loaded for launcher **Range – main armament:** 6.5km

Avibras Indústria Aeroespacial ▸ ASTROS

Since the Artillery Saturation Rocket System (ASTROS) entered service with the Brazilian Army in 1983, more than 180 launchers have been produced by Avibras for domestic and export customers, including Iraq, Malaysia, Qatar and Saudi Arabia. ASTROS is based on the Tatra 6x6 T815-7 chassis, equipped with a 12l V8 engine. The modular design enables the AV-LMU universal multiple launcher to fire various calibres of rockets and missiles, including 70mm AV-SS-09-TS (32 rounds); 127mm AV-SS-30 (32); 180mm AV-SS-40 (16); 300mm AV-SS-60 (4); 300mm AV-SS-80 (4); and 450mm AV-TM (2). Avibras offers a family of support vehicles based on the same chassis including: 6x6 AV-RMD ammunition supply vehicle; 4x4 AV-PCC battery C2 vehicle; 4x4 AV-VCC C2 vehicle; 6x6 AV-OFVE mobile workshop; 6x6 AV-UCF fire control unit; and 4x4 AV-MET mobile meteorological station. All vehicles feature an armoured crew cabin and can be fitted with a .50cal HMG or similar weapon for self-defence. The ASTROS can be carried by C-130.The Brazilian Army's ASTROS 2020 Strategic Project aims to equip units with the Mk 6 AV-LMU and improved munitions. **Type:** multi-calibre SP MRL **Length:** 10m **Width:** 2.7m **Max speed:** 110km/h on road **Range:** 600km on road **Powerplant:** Tatra V8 Euro 3 turbodiesel with intercooler **Crew:** 4 **Range – main armament:** 9-80km (rocket), 300km (missile)

BrahMos Aerospace ▸ BrahMos

The BrahMos is a ramjet supersonic cruise missile developed by BrahMos Aerospace, a joint venture between Russia's NPO Mashinostroeyenia and India's Defence Research and Development Organisation (DRDO). Based on the Yakhont supersonic cruise missile, the export version of Russia's P-800 (3M55) Oniks missile, the BrahMos can be launched from land-based mobile launchers, submarines, ships, and aircraft, and is in service with the Indian Army, Navy and Air Force. The BrahMos Block I was accepted into Indian Army service on 21 June 2007 and now equips five missile regiments including two formed in 2016. A land-based BrahMos battery typically consists of four to six Mobile Autonomous Launchers (MAL), based on a 12x12 Tatra heavy duty truck, controlled by a Mobile Command Post and supplied by a Mobile Replenishment Vehicle. The MAL carries three missiles in individual launch canisters which can be launched individually or in a salvo. The MAL's mast-mounted radar and fire control system enables each MAL to operate independently. Operational missiles carry a 200kg warhead to a maximum range of 290km. On 11 March 2017, an extended-range version of the BrahMos was successfully test launched at the Integrated Test Range at Chandipur. According to BrahMos Aerospace the BrahMos-ER will be able to strike targets at ranges up to 450km. BrahMos Aerospace is marketing the BrahMos to potential export customers. **Type:** self-propelled cruise missile launcher **Range – main armament:** 290km **Ammunition carried:** 3x missiles ready to launch

China Aerospace Long-March International ▸ A300

The A300 was the longest-range MRL system featured in China Aerospace Long-March International's 2015 catalogue. Like the earlier A100 and A200 launchers, the A300 uses 301mm rockets but the maximum range has been extended from 200km to 290km. The A300 is armed with eight ready to launch missiles mounted on a heavy-duty 8x8 chassis. The A300's guidance systems use a combination of inertial measuring unit and GPS guidance that according to the manufacturers provides 30m CEP when equipped with a unitary warhead and 45m with a 'shaped-charge fragmentation cluster' warhead. **Type:** 301mm SP MRL **Ammunition carried:** eight ready-to-launch missiles **Range – main armament:** 290mm

Emirates Defense Technology ▸ Mini-Jobaria

The EDT Mini-Jobaria is a modification of the Nimr Automotive Hafeet 6x6 APC to serve as a self-propelled MRL which can be configured to launch 107mm, 120mm or 128mm rockets from a rotating launcher mounted at the rear of the vehicle. In the 107mm configuration, the Mini-Jobaria carries 48 rockets which can be launched within two minutes to a maximum range of 12km. **Type:** SP 107mm, 120mm, 122mm MRL **Max speed:** 140km/h **Distance range:** 700km **Powerplant:** Cummins EUSB 190 diesel engine **Crew:** 2 **Main armament:** 48x107mm launch tubes **Range – main armament:** 12km (107mm type)

Excalibur Army ▸ RM-70 Vampir

The RM-70 Vampir 122mm MRL is an upgrade developed by Excalibur Army for the RM-70. The original RM-70, which entered Czechoslovakian service in 1972, used the launcher of the Soviet BM-21 MRL, mounted on a larger chassis which enabled an additional 40 rockets to be carried to reload the 40-round launcher. New or second-hand RM-70s were exported to more than 20 countries. The original RM-70 was based on a locally-produced Tatra T-813 8x8 chassis. The Vampir is based on a new Tatra T-815-7 8x8 chassis which is equipped with an eight-cylinder Tatra T3C engine coupled to a Tatra 10 TS 210 N gearbox with semi-automatic Tatra Norgren drive system. The Vampir features an armoured cabin to which additional ballistic protection can be fitted. The cab is equipped with an NBC defence system. A launcher for 40 122mm rockets is mounted on the rear of the vehicle with an additional 40 rockets carried for immediate reload. Rockets can be fired individually or in volleys. Construction of the first prototype began in February 2015 and successful firing trials were conducted in October 2015. **Type:** 8x8 MRL **Max speed:** 90km/h on road **Distance range:** 1,000km **Powerplant:** Tatra T3C engine **Crew:** 4 **Main armament:** 40x 122mm rockets ready to fire, 40x 122mm rockets in reserve **Rate of fire – main armament:** 40x 122mm rocket launcher **Ammunition carried:** 20km **Range – main armament:** 40 rockets in 30 seconds

SPECIFICATIONS

SELF-PROPELLED AIR DEFENCE MISSILES

This section provides a guide to self-propelled air defence missiles that are under development, in production or being substantially modernised.

The specifications listed here are intended to provide a handy reference source for the basic parameters that describe the weapon's performance. Most data has been supplied by the manufacturers, who can give more detailed information on request. Contact details are listed in the supplier guide.

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ABOVE: Soldiers load Stinger missiles into an AN/TWQ-1 Avenger air defence system before live-fire training in Capu Midia, Romania. (Photo: US Army)

Almaz-Antey ▸ 9K33 Osa

The 9K33 Osa (SA-8 *Gecko* NATO designation) self-propelled SHORAD system has been in Russian service since 1971 and remains in use with at least 18 other countries. Almaz-Antey markets the upgraded Osa-AKM, introduced into Russian service in 1980, as a complete system or an upgrade package. Six 9M33M3 missiles are mounted on a 6x6 9A33 transporter, erector, launcher and radar (TELAR) vehicle. The Belarus-based 2566th Plant for Repair of Radioelectronic Armament has developed the 9A33-1B TELAR vehicle for the Osa-AKM and is proposing its A33-2B vehicle as an upgrade for the original Osa system. **Vehicle weight:** 18.8t **Length:** 9.14m **Width:** 2.8m **Height:** 4.2m in travelling configuration **Ground clearance:** 400mm **Powerplant:** 300hp 5D20 B-300 diesel **Speed:** 60km/h on road, 10km/h in water **Range:** 500km **Trench:** 1.2m **Crew:** 5 **Length:** 3.158m **Diameter:** 210mm **Engine:** solid-propellant rocket motor **Missile velocity:** 540m/s **Effective altitude:** 80-16,400ft **Effective range:** 1,500-10,000m **Warhead:** HE fragmentation **Warhead weight:** 15kg

Almaz-Antey ▸ Antey-2500

The Antey-2500 is the export version of Russia's S-300VM (US/NATO designation SA-12 *Gladiator/Giant*) self-propelled anti-ballistic missile system, which is designed to destroy aircraft, tactical, ballistic and cruise missiles. Each tracked launcher carries four vertically launched missiles (either 9M82M or 9M83M). It is capable of simultaneously engaging two targets using a single launcher. In 2013, Venezuela became the first export customer to receive Antey-2500 systems. These were originally intended for Iran until Moscow cancelled the sale in 2010. On 12 November 2014, TASS quoted a senior official of Russia's Federal Service for Military-Technical Co-operation (FSMTC) as saying that the Antey-2500 had been sold to Egypt earlier in the year, but two days later the FSMTC denied the report. Russian newspapers also reported the $500 million sale of 22 launchers to an unidentified foreign customer. **Engine:** 2-stage solid propellant booster and sustainer rocket motors **Missile velocity:** 2,400m/s **Effective altitude:** 65ft for air-breathing targets/3,280ft for ballistic missiles to 98,000ft **Effective range:** 13-200km **Guidance system:** inertial with semi-active radar terminal homing **Warhead:** HE fragmentation **Warhead weight:** 150kg

Almaz-Antey ▸ Buk-M2

The Buk-M2 (designated SA-17 *Grizzly* by NATO) tracked self-propelled air defence system entered Russian service in 1995 and various models have been exported to more than 12 countries. Export models are designated Buk-M2E. It is designed to defeat aircraft, helicopters, UAVs and cruise missiles. The tracked launch vehicle carries four 9M317-family missiles on a turntable launcher plus a phased-array radar. A wheeled variant is also available. A complete unit would include the following vehicles: command post; target acquisition radar; illumination/missile guidance radar; loader-launcher; and launcher. An improved Buk-M3 entered Russian service in late 2016. **Length:** 5.083m **Weight:** 715kg (9M317) **Diameter:** 400mm **Engine:** 2-phase solid propellant rocket motor **Missile velocity:** 1,230m/s **Effective altitude:** 50-82,000ft **Effective range:** 3,000-42,000m **Guidance system:** multi-mode terminal semi-active radar homing **Warhead:** HE fragmentation **Warhead weight:** 50-70kg

Almaz-Antey ▸ S-125 Pechora-2

The original S-125 Pechora (NATO designation SA-3 *Goa*) was first deployed by the Soviet Union in the early 1960s to protect Moscow. A ground launcher can be armed with two or four missiles, while a truck-mounted launcher carries two missiles. The S-125 was used by at least 45 countries and remains in service in about 30. The trucked-mounted Pechora-2, introduced in 2000, features improved range, a multiple target engagement capability and a higher kill probability. The Russian-Belarus Oboronitelniye Sistemi (Defence Systems) JV continues to develop upgrades for the Pechora with the latest standard being the S-125-2M. The improved 5V27DE missile used by the S-125-2M has a range of up to 32km and the JV is working to extend the range to 60km. Other companies, including Tetraed of Belarus, Lithuania's LiTak-Tak and Ukraine's Aerotechnica, also offer S-125 upgrade packages. In 2001, the Polish Air Force began fielding the S-125SC Newa-SC upgrade developed locally by WZE which incorporates numerous improvements as well as reducing dependence on Russian components. This upgrade features a four-missile launcher mounted on a WZT-1 tank chassis, an IFF capability, data links and digital rather than analogue components.

Almaz-Antey ▸ S-400 Triumf

The S-400 Triumf (NATO reporting name: SA-21 *Growler*) long-range air defence system, previously known as the S-300PMU-3, was developed by the Almaz Central Design Bureau in the 1990s as an upgrade of Russia's S-300 (see separate entry) family and entered Russian military service in 2007. A Russian S-400 battalion typically consists of a command post and eight 5P85TE2 SP launchers or eight 5P85SE2 trailer launchers. Each launcher carries four missiles. The S-400 can launch three missiles: the medium-range 9M96 (40km for the 9M96E, 120km for the 9M96E2) missile; the long-range (250km) 48N6; and the extremely long-range (400km) 40N6 missile. China has expressed an interest in acquiring six battalions, but as of May 2016, no agreement had been signed. On 18 December 2015, the Indian government approved the Indian Air Force's purchase of five S-400 systems, including 6,000 missiles, for about $6 billion. That same month, Almaz-Antey signed an agreement with India's Reliance Defence Limited (RDL) to collaborate on developing and producing missiles and radars. An RDL statement said potential cooperation includes Almaz-Antey's Tor-1M and the S-400. In January 2017, the Russian MoD announced that four air defence regiments were rearmed with the S-400 in 2016 and that another four regiments will be equipped in 2017. Turkish President Recep Tayyip Erdoğan confirmed on 25 July that Turkey is buying an unspecified number of S-400 systems. On 4 October 2017, the Saudi Arabian MoD signed an agreement with the Russian government to buy an unspecified number of S-400 systems as part of a larger Russian arms package. On 13 November 2017, the Russian Ministry of Defence (MoD) announced that an air defence missile unit of the Russian

armed forces' Eastern Military District (MD) Air and Air Defence Army, located in the Primorsky Krai, has been rearmed with the S-400 anti-aircraft missile system. On 18 January 2018, it was announced that Moscow has begun the delivery of the S-400 Triumf air defence missile systems to China under the 2014 contract. The delivery announcement was made by the Russian government-controlled Tass News Agency and confirmed by various industry sources in Moscow. Attributes for the 40NE6 missile. **Missile weight:** 1893 kg **Effective range:** 400 km **Guidance system:** Semi-active radar homing **Warhead weight:** 180 kg

Almaz-Antey ▸ Tor-M1

The tracked Tor-M1 (designated SA-15 *Gauntlet* by NATO) self-propelled air defence system is designed to defeat aircraft, helicopters, UAVs and cruise missiles flying at medium, low and extremely low altitudes. The system has been in Russian service since 1986 and is used by nine other countries. Tor-M1 uses the 9A331 launch vehicle produced by Metrovagonmash. Eight 9M330 or 9M331 missiles are vertically launched from the turret which mounts a 3D pulse-Doppler radar on top and a phased-array pulse-Doppler K-band tracking radar in front. The system can also be supplied in containerised configuration, which can be mounted on a truck or used as a static system. At India's Defexpo in February 2014, Almaz-Antey promoted the Tor-M2KM which it is proposing for India's requirement for a new SHORAD. For this the 9A331MK-1 module would be installed on a Tata 3138C 8x8 truck. At Airshow China in November 2014, Almaz-Antey said the company is planning to open a facility in China which would be able to maintain and upgrade the PRC's Tor-M1 systems. Vehicle specifications (9A331 launcher): **Weight:** 34t **Length:** 7.5m **Width:** 3.3m **Height:** 5.1m with radar erected Max speed: 65km/h on road **Range:** 500km **Crew:** 4 **Length:** 2.895m **Weight:** 165kg **Diameter:** 230mm **Engine:** thruster jets with 2-stage eject and solid propellant rocket motor **Missile velocity:** 860m/s **Effective altitude:** 32-23,000ft **Effective range:** 1-12km **Guidance system:** radio command guidance **Warhead:** HE fragmentation **Warhead weight:** 15kg

Aselsan ▸ Atilgan

Developed for the Turkish Armed Forces, the Atilgan mounts Aselsan's Pedestal Mounted Air Defence System (PMADS) on a tracked M113A2. Its primary mission is to provide low-level air defence for manoeuvre forces, convoys, forward-operating bases and similar locations. The gyro-stablised PMADS turret is equipped with eight ready-to-launch Raytheon Stinger missiles in two pods of four, and a .50cal HMG. The sensor suite incorporates a two-FoV FPA thermal imager, a daylight TV camera for passive day/night surveillance and a laser rangefinder. Eight missiles are carried inside the vehicle. Atilgan is operated by a crew consisting of commander, gunner and driver. Aselsan has also developed a variant of the PMADS which fires Russian Igla SAMs. Turkish Land Forces Command operates 70 Atilgans delivered from 2001.

SPECIFICATIONS

GROUND-LAUNCHED AIR DEFENCE MISSILES

This section provides a guide to static and towed ground-launched air defence missiles that are under development, in production or being substantially modernised.

The specifications listed here are intended to provide a handy reference source for the basic parameters that describe the weapon's performance. Most data has been supplied by the manufacturers, who can give more detailed information on request. Contact details are listed in the supplier guide.

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ABOVE: US soldiers conduct march order emplacement and system validation for an MIM-104 Patriot missile battery at an Israeli exercise site during *Juniper Cobra*. (Photo: USAF)

Almaz-Antey ▸ S-125-2A Pechora-2A

Almaz-Antey offers the S-125-2A Pechora-2A upgrade package for the S-125 Pechora (US/NATO designation SA-3 *Goa*) static and towed medium-range SAM system that first entered Soviet service in 1961. The S-125 Pechora-M upgrade was introduced into Russian service in 1994. Although the S-125 has been withdrawn from Russian service, it remains in use in at least 25 countries. The original 5P73 four-rail launcher was designed for static applications. The upgrade offers customers the choice of a 5P73 or the two-rail 5P73-2 mounted on a Kamaz 6x6 cross-country truck to produce a mobile system. The Pechora 2A replaces more than 50% of the old analogue systems with new digital components as well as other modifications to improve target engagement, extend the kill zone, enhance ECCM capability and provide automatic tracking, says the company. Specifications for upgraded 5V27. **Effective altitude:** 65-65,500ft **Effective range:** 3,500-28,000m

IAI Israel Aerospace Industries ▸ Barak 8

In early 2006, India's Defence Research and Development Organisation (DRDO) and the Israeli MoD signed a contract with IAI for the joint development of the Barak 8 Long Range SAM system, based on the Barak 1 SAM, which IAI developed in collaboration with Rafael, for the Indian Navy. The project was subsequently expanded to include the land-based Barak 8 Medium Range SAM (MR-SAM) for the Indian Air Force and the Indian Army. The land-based Barak 8 MR-SAM system consists of a C2 system, tracking radar, launchers and missiles. Each trailer-mounted launcher is armed with eight missiles in their canisters. In February 2017, the Indian government approved a $2.6 billion project, which includes about 40 Barak 8 MR-SAM launchers and 200 missiles for the army, as well as missiles for the navy, to be delivered by 2023. India's Bharat Dynamics Ltd will collaborate with IAI on the project. IAI markets the Barak 8 directly to potential export customers. On 31 August 2017, IAI announced that the company, as well as India's DRDO had delivered the first LR-SAM manufactured in India to the Indian Ministry of Defence. **Engine:** 2-stage, smokeless pulsed rocket motor **Max speed:** 680m/s

Lockheed Martin Missiles and Fire Control ▸ Aegis Ashore

Aegis Ashore is the first operational land-based version of the Aegis Combat System, originally developed by Lockheed Martin for the USN. The system is deployed on more than 100 ships of the USN and five allied nations. The first operational Aegis Ashore installation was opened at Deveselu, Romania in May 2015, and a second site is scheduled to open in Redzikowo, Poland in 2018. Both are part of the European Phased Adaptive Approach to provide ballistic missile defence (BMD) for NATO countries and US forces deployed in Europe. All elements of Aegis Ashore, including the SPY-1 air search radar, the Aegis Weapons Control System and the MK 41 Vertical Launching System, are already in use in land-based applications in the USA that range from development and integration test facilities to launch and production test facilities. The heart of the Deveselu site is a SPY-1D(V) radar linked to three 8-cell MK 41 launchers armed with Raytheon Standard Missile 3 (SM-3) Block IA and IB interceptors. In 2020, both sites are scheduled to receive the latest version of the Aegis BMD software and the new Block IIB version of the SM-3 missile. On 19 December 2017, the Japanese cabinet approved a plan to purchase two Aegis Ashore systems to increase Japan's self defence capability against North Korea.

Rafael Advanced Defense Systems ▸ DSWS

The David's Sling Weapon System (DSWS), the latest element in Israel's layered air defence system, is designed to defend Israel against large-calibre rockets, short-range ballistic missiles, manned and unmanned aircraft, cruise missiles and other developing threats. Prime contractor Rafael received a development contract in 2006 while Raytheon Missile Systems is the principle sub-contractor. The Multi-Mission Radar (MMR) was developed by Elta and the Battle Management Center (BMC), known as the Golden Almond, was developed by Elisra. The MMR detects the target after launch and transfers flight information to the BMC, which calculates the defence plan and passes information to the trailer-mounted Missile Firing Unit, each of which has 12 vertical launch canisters for the Stunner missile. The Stunner is a two-stage hit-to-kill missile with a radar and an EO sensor installed in its nose. According to the manufacturer, the Stunner has a speed of Mach=7.5/9, 260km/h and can engage targets at ranges up to 300km and an altitude of 246,000ft. David's Sling was delivered to the IDF in July 2016, and at a ceremony on 2 April 2017 two batteries, sufficient to cover the country, were declared officially operational. The US Missile Defense Agency is evaluating the Stunner for future US requirements. **Max speed:** Mach=7.5/9, 260km/h **Effective altitude:** 246,000ft **Effective range:** 300km

Raytheon ▸ PAC-3

The MIM-104 Phased Array Tracking to Intercept of Target (PATRIOT) Advanced Capability-3 (PAC-3) is a long-range, medium- to high-altitude, all-weather air defence system designed to counter tactical ballistic missiles, cruise missiles and advanced aircraft. The original PATRIOT entered US Army service in 1984 and was followed by the PAC-1, PAC-2, PAC-2 Guided Enhanced Missiles and, from 1995, the PAC-3 Configuration 1. The US Army has acquired more than 1,100 launchers, and PATRIOT is in service with five other NATO members and nine other countries. The system was first used in combat during the 1990-91 Gulf War. A PATRIOT fire unit consists of a phased-array radar, engagement control station, battery command post, electric powerplant, antenna mast group, communications relay group and six M901 launching stations with missiles. A total of 16 PAC-3 missiles can be loaded on a launcher. The PAC-3 Missile Segment Enhancement (MSE), currently being developed by Lockheed Martin, is planned to be used with PAC-3 systems and MEADS, and the US Army intends to order 1,680 missiles. In five PAC-3 and MSE tests in 2013, the missiles destroyed four ballistic missiles and three cruise missiles. Through the Pure Fleet project, the US Army plans to upgrade all its PATRIOTS to PAC-3 configuration. In July 2016, the US Army declared initial operational capability for the MSE. Raytheon received a $769.4 million contract in March 2015 to upgrade South Korea's PATRIOT PAC-2 missiles to the 3+ configuration. In June 2016, it received a $523 million contract to modernise six PATRIOT fire units to 3+ configuration for Kuwait. On 3 June 2014, Poland announced that the PATRIOT is one of two systems shortlisted for its $7.9 billion air defence project. In July 2016, Poland's state-owned PGZ defence group signed a letter of intent with Raytheon to

cooperate on the project. On 10 July 2017, the US Congress was notified of a possible $3.9 billion FMS to Romania of seven PAC-3+ fire units, including 28 launchers, 56 MIM-104E Guidance Enhanced Missile-TBM (GEM-T) missiles and 168 PAC-3 MSE missiles. Romania will be the 13th international customer for the PATRIOT. On 7 November 2017, Sweden's FMV defence procurement agency announced that it would begin negotiations with the US government to acquire the PATRIOT. The contract could be worth $1.2 billion, and Sweden plans to have the system fully operational by 2025. On 8 February 2018, Lockheed Martin announced that it received a contract modification for the production and delivery of PAC-3 and PAC-3 MSE interceptors. The $524 million modification contract is in addition to the $944 million production and delivery contract awarded in December 2017. **Effective altitude:** 79,500ft **Effective range:** 20km against ballistic missile (PAC-3:), 35km against ballistic missile (PAC-3 MSE) **Guidance system:** Ka-band AESA seeker (PAC-3)

Saab ▸ BAMSE

BAMSE, designated RBS 23 in Swedish service, is a medium-range, all-weather-capable air defence system developed to meet Swedish requirements. The system consists of a Surveillance and Control Centre (SCC) and two to four Missile Control Centres (MCC), which can be located up to 20km away from the SCC and connected via cable or radio. Operated by a crew of one or two, the SCC is equipped with a Saab Giraffe 3D surveillance radar. The MCC trailer has two computer stations and is operated by one or two personnel. It is equipped with a Ka-band fire control radar with an 8m mast, IR sensor for surveillance and tracking, IFF, weather sensors and six ready-to-fire BAMSE missiles. The MCC can be deployed within 10min, while a complete missile reload takes less than 4min. Although based on the laser-beam riding RBS 70, BAMSE missile is a radar C2 missile and is equipped with a booster to extend its range. The missile is equipped with a fragmentation and shaped charge warhead, with both a proximity fuse and an impact fuse. Following a contract in 2000, the first production system was delivered to the Swedish Army in late 2008. In February 2014, Saab announced a collaborative venture with Ashok Leyland to offer the BAMSE system mounted on the Indian company's Super Stallion 8x8 cross-country truck to compete for the Indian Army's Short-Range SAM requirement. In November 2014, Saab announced that it had partnered with PT Pindad to market the BAMSE as a solution to upgrade Indonesia's RBS 70 VSHORAD system. **Engine:** solid propellant booster and sustainer rocket motors **Effective altitude:** 49,200ft **Effective range:** 20km **Guidance system:** automatic CLOS **Warhead:** fragmentation and shaped charge with proximity and impact fuse

SPECIFICATIONS

MANPORTABLE AIR DEFENCE MISSILES

This section provides a guide to manportable air defence missiles that are under development, in production or being substantially modernised.

The specifications listed here are intended to provide a reference source for the basic parameters that describe the weapon's performance. Most data has been supplied by the manufacturers, who can give more detailed information on request. Contact details are listed in the supplier guide.

Entries are listed alphabetically by company.

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ABOVE: Soldiers train using a variety of weapons, including AT-4 antitank weapons and the RBS-70 short-range air defence laser-guided missile system. (Photo: US Army)

CPMIEC ▸ FN-6

The passive IR homing FN-6 MANPADS is in service with the PLA (designated HY-6) and has been exported to Cambodia, Malaysia, Peru and Sudan. The missile is capable of all-aspect attack and according to CPMIEC has a 70% single-shot hit probability. It can be fitted with a clip-on optical sight and an IFF unit. Vehicle-mounted and naval launchers are in service. **Length:** 1.5m **Weight:** 17kg including 10.7kg missile in launch tube **Diameter:** 71mm **Engine:** solid propellant booster and sustainer rocket motors **Missile velocity:** 600m/s **Effective altitude:** 50-12,500ft **Effective range:** 500-5,500m **Guidance system:** IR

KBM ▸ Igla

The Igla ('Needle') IR-homing MANPADS entered Soviet Army service in 1981 and members of the family have been sold to more than 30 countries. The original 9K310 Igla-1 (US DoD designation SA-16, NATO reporting name *Gimlet*) was joined by the 9K38 Igla (SA-18 *Grouse*) in 1983 and the latest version, the 9K338 Igla-S (SA-24 *Grinch*), in 2004. The Igla family has replaced the Strela (SA-7 *Grail*) family in Russian service. Various vehicle and naval launchers for the Igla are available. The fire-and-forget Igla-S can be used to engage combat aircraft, helicopters, UAVs and cruise missiles both approaching and receding. The range of the missile has been extended from the original Igla's 5,200m to 6,000m. Other improvements include: increased lethality; proximity detonation; detonation of remaining solid propellant on impact; and improved accuracy. The new 1PN97M Mowgli-2M night sight has been developed for use with the Igla-S. A senior KBM official said in March 2014 that Igla-S could be built in Brazil for export following Brazil's latest purchase of the Igla-S and other air defence systems in October 2013, and in April 2014 KBM announced that Singapore was considering an Igla-S acquisition. **Length:** 1.64m, 1.7m in launch tube **Weight:** 19kg ready to launch with 11.7kg missile in launch tube **Diameter:** 72.2mm **Engine:** solid fuel booster and sustainer rocket **Missile velocity:** 400m/s **Effective range:** 6,000m **Guidance system:** IR **Warhead:** HE fragmentation **Warhead weight:** 2.5kg **Crew:** 1

LIG Nex1 ▸ Chiron

LIG Nex1 developed the Chiron MANPADS to meet an ROK Army requirement for a system able to engage fixed-wing aircraft, helicopters, UAVs and cruise missiles. Series production began in 2005 and the Chiron entered South Korean service the following year. The missile is launched from a pedestal firing post that has an adjustable seat for the gunner and incorporates a two-handed firing grip. The missile has integrated IFF systems, night and adverse weather capabilities, a two-colour IR/UV seeker to overcome IR countermeasures and a proximity fuse warhead. The Chiron can be used independently, but in South Korean service is typically linked to a truck-mounted TPS-830KE low-altitude surveillance radar. In November 2012, the Peruvian Army decided to purchase 18 Chiron launchers, 108 missiles and three TPS-830KE radars, but the $43 million contract was cancelled in May 2013 because of differences over payment. **Length:** 1.68m, 1.87m in launch tube **Weight:** 19.5kg including 14kg missile in launch tube **Diameter:** 80mm **Engine:** dual-thrust solid propellant rocket motor **Missile velocity:** 700m/s **Effective altitude:** 11,500ft **Effective range:** 7,000m **Guidance system:** IR homing **Warhead:** HE fragmentation with 7,200 fragments **Warhead weight:** 2.5kg **Crew:** 2

MBDA ▸ Mistral 2

Developed to meet French military requirements, the Mistral MANPADS has been fielded in numerous variants, including manportable, vehicle-mounted and naval, by 37 armed forces in 25 countries since series production began in 1989. In 2000, MBDA switched production from the Mistral 1 to the Mistral 2, which has achieved a 96% success rate in more than 3,000 live firings. Mistral 2 has improved electronics and signal processing, an enhanced IR seeker unit, a new booster motor and aerodynamic improvements including new fin and control surfaces. Mistral 2 is compatible with all Mistral 1 launchers. In the MANPADS role, the system is broken into two 25kg loads – the pedestal mount and associated equipment, and the missile in its launch container – for carriage by the commander and gunner. The pedestal firing post is equipped with an adjustable tripod, an adjustable gunner's seat and a two-handed firing grip. The launcher can be used as an autonomous unit, but is usually linked with others through a fire control centre to provide integrated coverage. It takes less than a minute to assemble the Mistral for launch. The pedestal-mounted twin-round ATLAS launcher can also be used in the MANPADS role. **Length:** 1.86m, 2m in launch tube **Weight:** 18.7kg **Diameter:** 93mm **Engine:** SNECMA solid fuel sustain and eject motor **Missile velocity:** M=2.6 **Effective altitude:** 9,800ft **Effective range:** 600-6,500m **Guidance system:** passive IR **Warhead:** HE fragmentation with high-density tungsten balls **Warhead weight:** 3kg **Crew:** 2

SPECIFICATIONS

SELF-PROPELLED AIR DEFENCE GUNS

This section provides a guide to self-propelled air defence gun systems that are under development, in production or being substantially modernised.

The specifications listed here are intended to provide a handy reference source for the basic parameters that describe the weapon's performance. Most data has been supplied by the manufacturers, who can give more detailed information on request. Contact details are listed in the supplier guide.

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ABOVE: Romanian soldiers observe their sector of fire from a Flakpanzer Gepard during Exercise *Combined Resolve VIII* at the Hohenfels Training Area, Germany. (Photo: US Army)

Ares Aerospacial e Defesa ▸ TORC30

The TORC30 is a stabilised unmanned turret armed with a Rheinmetall MK30-2/ABM 30mm cannon being developed by Ares, an Elbit subsidiary, and the Brazilian Army's CTEx Science and Technology Centre for integration on various wheeled and tracked armoured vehicles. The TORC30 is intended to engage both ground and air targets using Rheinmetall's 30mm air burst munition. The gunner is equipped with a 15x zoom day TV camera, a 10x zoom thermal imager and a laser rangefinder with a similar independent sight system available for the commander. The dual-feed cannon is fed from 150 and 50 round magazines. Secondary armament is a 7.62mm FN Herstal MAG machine gun with 500 ready rounds. Ares is examining the integration of an antitank guide weapon launcher. Basic STANAG 4569 Level 2 ballistic protection can be increased to Level 4. The turret is equipped with eight 76mm smoke grenade launchers, a laser warning system can be fitted and Ares plans to integrate a shot detection system. Ares displayed their first prototype of the TORC30 unmanned turret in Brazil at the LAAD exhibition in April 2017. **Type:** unmanned 30mm turret **Elevation:** -5/+85° **Traverse:** 360° **Primary weapon:** Rheinmetall MK30-2/ABM cannon **Secondary weapon:** 7.62mm FN MAG coaxial MG **Smoke grenades:** 8x 76mm **Crew:** 2 (commander, gunner) **Protection:** STANAG 4569 Level 2, 3 or 4 **Ammunition:** 1x 50 round and 1x 150 round 30mm magazine, 500x 7.62mm ready rounds

Aselsan ▸ Korkut

The Korkut SPAAG was developed to meet a Turkish Land Force Command (TLFC) requirement by a team led by Aselsan as prime contractor, with FNSS Savunma Sistemleri and MKEK. FNSS developed the tracked 30t ACV 30, a wider and longer vehicle on the basis of its ACV 19, for the project. The vehicle carries an unmanned turret equipped with twin MKEK 35mm cannon, a tracking radar and an EO fire control system for all-weather target engagements. Seated inside the hull are the commander, gunner and driver. The ACV-30's all-welded aluminium armour hull incorporates mine protection measures and can be fitted with appliqué armour plates to improve ballistic protection. MKEK cannon are licence-built versions of the Rheinmetall Air Defence Oerlikon 35mm KDC-02 cannon, which fire 35mm HE-I and target practice-tracer (TP-T) ammunition and a new 35mm air bursting munition (ABM) developed by Aselsan and MKEK. A typical Korkut section would comprise three SPAAGs and a C2 system that uses the ACV30 chassis equipped with a turret-mounted Aselsan 3D monopulse search radar for tracking and acquisition of targets to a maximum range of 70km. Korkut has a maximum speed of 65km/h and a range of up to 500km. To meet TLFC's requirements, Korkut is fully amphibious and is propelled in water by a pair of waterjets. Turkey's SSM defence procurement agency awarded Aselsan a contract to deliver a CCS and two SPAAGs for trials which began in 2015. **Type:** tracked twin-barrel SPAAG **Length:** 7m **Width:** 3.9m **Height:** 2.2m to top of hull **Max speed:** 65km/h on road **Calibre:** 35x228mm **Crew:** commander, gunner, driver **Rate of fire:** 1,000rpm **Ammunition:** HE-I, ABM, TP-T

Hanwha Defense ▸ K30 Bi Ho

The K30 Bi Ho (Flying Tiger) is a twin 30mm SPAAG developed by Doosan to meet the requirements of the Republic of Korea Army (ROKA). Deliveries began in 1996. The tracked K30 is based on the chassis of the Doosan K200 IFV, modified with a more powerful engine and extra road wheel to accommodate the heavier air defence turret. Mounted either side of the turret is a Rheinmetall 30mm KCB-B cannon each provided with 250 rounds. The guns have an effective range of 3,000m. Fitted on the rear of the turret is a TPS-830K surveillance and fire control radar able to track targets from a range of 17km. The system is also equipped with an EO targeting system, FLIR, a laser rangefinder, a TV camera and a digital FCS. On 27 December 2013, South Korea's Defense Acquisition Program Administration (DAPA) announced that Doosan, LIG Nex1 and Samsung Thales will collaborate in the production of a new air defence system which integrates LIG Nex1's KP SAM Shin-Gung MANPADS with the K30. Development of the system, led by Doosan, began in 2010 and production weapons are scheduled to be delivered to the ROKA from 2015. **Weight:** 25t **Length:** 6.97m **Width:** 3.17m **Height:** 4.4m with radar deployed **Powerplant:** 520hp D2840L diesel **Speed:** 60km/h on road **Range:** 500km on road **Fording:** 1.2m w/o preparation **Gradient:** 60% **Side Slope:** 30% **Crew:** 4 **Calibre:** 30x170mm **Effective range:** 3,000m **Elevation:** -10/85° c360° **Rate of fire:** 600rpm

Hanwha Defense ▸ K263 Cheongoong

The K263 Cheongoong SPAAG mounts the KM167A1, a locally produced version of the General Dynamics 20mm M61 Vulcan gun, on the tracked K200 Korea Infantry Fighting Vehicle chassis to provide a mobile very low-altitude air defence system for the Republic of Korea Army (ROKA). The M61 Vulcan is a hydraulically or pneumatically driven, six-barrel, air-cooled, electrically fired Gatling-style cannon, which has been in US service since 1959 in numerous applications. With a rate of fire of 3,000rpm, the weapon is lethal against air targets at ranges up to 1,500m and can also be employed against ground targets. The K200 and its derivatives were in production from 1985-2006. The original K263 vehicle was upgraded to the K263A1 standard with the more powerful engine and transmission, NBC protection and automatic fire extinguishing system of the K200A1 vehicle. The upgraded K263A3 has an improved fire control system. The K263 is being replaced in ROKA service by the Doosan K30 Bi Ho. **Weight:** 13.2t combat **Powerplant:** Doosan D2848T diesel **Speed:** 70km/h on road **Speed in water:** 6kmk/h **Range:** 480km on road **Gradient:** 60% **Side slope:** 30% **Vertical obstacle:** 630mm **Trench:** 1.68m **Crew:** 4 **Calibre:** 20mm **Effective range:** 1,500m **Rate of fire:** 3,000rpm **Barrel:** 6 barrel Vulcan gun

Krauss-Maffei Wegmann ▸ Gepard

The Gepard was developed from 1963 to meet a German Army requirement for a SPAAG that could support its armoured forces. The first of 420 systems entered German service in 1975, 55 were built for Belgium and 95 were built for the Netherlands as the Cheetah. Mounted on a modified Leopard 1 hull is a fully rotating turret carrying a pair of 35mm Oerlikon KDA autocannons, with a search radar at the rear of the turret and a tracking radar and a laser rangefinder at the front between the guns. Each gun has a firing rate of 550rpm. Belgian, Dutch and German weapons have all been withdrawn from service with their original operators and offered for sale. Germany donated 43 Gepards to Romania in 2004. In May 2013, Brazil bought surplus German Army Gepard 1A2s. In 2013, Jordan bought 60 surplus Cheetahs from the Netherlands as part of a package that also included 350,000 35mm rounds and 11 Thales Flycatcher radars. **Length:** 7.68m **Width:** 3.71m **Height:** 3.29m with radar retracted **Weight:** 47.5t **Calibre:** 35mm **Traverse:** 360° **Crew:** driver, gunner, commander **Rate of fire:** 550rpm

Leonardo Defence Systems ▸ Draco

Designed for a range of missions, including air defence, C-RAM and ground combat, the Draco 76mm multirole weapon system is armed with Leonardo's 76/62 Super Rapid naval gun in a remote-control turret. According to Leonardo, 76mm is the optimum calibre for such roles, offering greater range and a larger 10m burst radius compared to smaller-calibre ammunition. Fed from a 12-round drum magazine in the rear of the turret, with a further 24 rounds stowed in an automatic feeding system, the stabilised 76mm gun has a rate of fire of up to 80rpm. Draco can fire all current 76mm naval rounds including the HE – Multi-role OTO Munition with a pre-formed fragmentation warhead. It can also fire the new 76mm Driven Ammunition Reduced Time of Flight (DART) guided munition, which has a pre-fragmented warhead, a 3AP microwave proximity fuse and an RF receiver for continuous guidance. Proving trials using the first production lot of DART ammunition for the Italian Navy were completed in March 2014. While the first example of the 5.5t Draco turret was shown in June 2010 integrated onto a Centauro, it can also be integrated onto other wheeled and tracked chassis weighing about 15t or more, and even be fitted to a container for use in a static role. The system is operated by a crew of two – a commander and gunner – who sit within the chassis or container with their own 30cm LCD display. A roof-mounted radar tracks targets and guides DART munitions. In the basic configuration, the commander has: a roof-mounted stabilised panoramic sight, with a day camera with wide and narrow FOVs and a 10x zoom thermal imager with wide and narrow FOVs; and an eye-safe laser rangefinder. The gunner can also be equipped with a roof-mounted stabilised sight incorporating a day/night image-intensification camera, daylight colour TV camera and a laser rangefinder. The all-welded steel armour Draco turret provides STANAG 4569 Level III ballistic protection, which can be increased to Level IV. Leonardo and the UAE's Tawazun signed an MoU to market and produce the Draco in the Middle East market under the name Samoum. **Calibre:** 76mm **Effective range:** 8km against helicopters, 6km missiles and UAVs, 3km direct ground fire, 15km indirect **Elevation:** +75/-10° **Traverse:** 360° **Rate of fire:** 80rpm **Ammunition:** all current 76mm naval rounds, DART munition

Minotor-Service ▸ ZSU-23-4 Shilka

The ZSU-23-4 Shilka tracked SP four-barrel 23mm anti-aircraft gun was developed in 1957-65 by Mytishchi Engineering Works to meet the requirement of the Soviet Army for a SPAAG to protect its armoured formations. An estimated 6,500 systems were built before production in the Soviet Union ended in 1982, and many of these systems remain operational in more than 35 countries, including Egypt, India, former Soviet client states and former states of the USSR. As part of the defence cooperation between Belarus and Russia, Minotor refurbishes the chassis of the ZSU-23-4 systems which remain in Russian service. According to Minotor, the improvements include increased maximum road speed from 30 to 40km/h, enhanced driver ergonomics, simpler repairability and reduced maintenance. More extensive modifications offered by Minotor include: installation of twin Igla MANPADS launcher; installation of a self-protection and laser-warning system; replacement of active night viewing devices by passive ones; and, replacing the APU gas turbine engine with a more economical diesel engine. **Width:** 3.13m **Height:** 3.57m **Weight:** 20t **Max speed:** 50 km/h on road **Distance range:** 450 km/h on road **Gradient:** 60% **Side slope:** 30% **Fording:** 1m **Trench:** 2.8m **Crew:** 4 **Rate of fire:** up to 200rpm **Turret – traverse:** 360˚

Norinco ▸ CS/SA1

Norinco markets its CS/SA1 35mm truck-mounted SPAAG as part of a complete system, along with its vehicle-mounted AF902A FCS and its programmable time fuze pre-fragmented ammunition. The system is designed to defeat fighters, helicopters, UAVs, cruise missiles and other targets at low altitudes. The CS/SA1 mounts the twin 35mm Type 90 towed anti-aircraft gun, a licence-produced copy of the Rheinmetall GDF series, on a Wansham WS-2400 6x6 cross-country truck chassis. It is equipped with an EO sight enabling it to operate independently. The system is operated by a crew of four. The AF902A FCS is equipped with a dual-band radar enabling it to detect aircraft at a maximum range of 35km and altitude of 6,000m, and cruise missiles at 15km. It is operated by a crew of three. Norinco recommends a battery should consist of one AF902A and two-four CS/SA1s. **Weight:** 19t **Max speed:** 90km/h on road **Range:** 600km on road **Crew:** 4 **Muzzle velocity:** 1,170m/s **Calibre:** 35mm **Effective range:** 4,000m, 3,000m effective altitude **Rate of fire:** 2x 550rpm **Ammunition:** 378 rounds

Norinco ▸ LD2000

Norinco revealed in 2005 that it was developing the LD2000 self-propelled close in weapon system (CIWS) to provide point defence for high-value targets. Each system consists of two trucks, an 8x8 vehicle carrying an enhanced 730B seven-barrel 30mm Gatling-type gun and a Norinco Mercedes-Benz 6x6 intelligence and command vehicle, which combines a search radar with a fire direction centre. The gun vehicle mounts a power-operated turret, based on the Type 730 CIWS in service with the PLA Navy, which is operated remotely by a gunner located in a fully enclosed cab to the rear of the two-door driver cab. The 30mm gun has a rate of fire of up to 4,200rpm and a maximum effective range of 2.5km. 1,000 rounds of ready-use 30mm ammunition, a combination of AP discarding sabot (APDS) and HE incendiary, are carried. According to Norinco, this is sufficient for about 48 target engagements. A J-band tracking radar, with a 9km maximum range, is mounted on the upper part of the turret, and to the right of the antenna is an EO package including a TV/IR tracking system and laser rangefinder with a range of between 5 and 18km. **Calibre:** 30mm **Effective range:** 2.5km **Rate of fire:** up to 4,200rpm (adjustable) **Ammunition:** APDS, HEI

Rheinmetall Air Defence ▸ Oerlikon Skyranger Gun System

The Oerlikon Skyranger mobile air defence system, unveiled at Eurosatory 2004, consists of three elements: the Skyranger Gun System; the Skyranger Missile Launcher System, based on the Rheinmetall ASRAD; and the Skyranger command post vehicle, with reconnaissance radar. A fire unit consists of one command vehicle and a mix of up to six gun and missile vehicles which would be employed in a two-layer air defence concept. Missiles would be used to engage targets such as fixed-wing aircraft, helicopters and UAVs, while guns would be used for close-range engagement of any targets that evade the missiles. The Gun System is a 3.5t remote-controlled turret armed with a Rheinmetall Air Defence 35/1000 revolver cannon which, like the other individual components, can be integrated into any suitable tracked or wheeled tactical vehicle to meet customer requirements. The prototype was mounted in a General Dynamics European Land Systems 8x8 Piranha APC. To improve lethality, the cannon fires Rheinmetall's 35mm Advanced Hit Efficiency and Destruction (AHEAD) smart-fused air defence projectile, which is programmed to eject 152 sub-projectiles ahead of an incoming target. A total of 220 rounds are carried inside the turret and customers can request a dual-feed system, which would also feed frangible AP discarding sabot ammunition. Mounted on the turret roof is an EO tracking system that includes an IR camera, TV camera and laser rangefinder. **Calibre:** 35x228mm **Effective range:** 4km max **Elevation:** -15°/+85 **Traverse:** 360° **Rate of fire:** 1,000rpm **Ammunition:** AHEAD, FAPDS

Thales ▸ RapidFire

Thales unveiled the RapidFire SPAAG, intended to protect both mobile forces and key assets/fixed points, at the Eurosatory 2012 exhibition. The system is designed to exploit the 40mm Cased Telescoped Armament System developed by CTA International, a JV company owned by BAE Systems and Nexter. The systems mount a turret developed by Nexter on a Mercedes-Benz Unimog U5000 6x6 chassis modified by Soframe. The truck has four stabilisers, which can be deployed in less than a minute. The system would usually halt and deploy the stabilisers before firing, but the gun can also be fired on-the-move for self-defence. Nexter has developed an anti-aerial airburst (AA-AB) munition, fused to blast a cloud of more than 200 tungsten pellets in the path of a target, specifically for the air defence role. The RapidFire carries 140 ready-to-use rounds in the turret, a mix of AA-AB for use against aerial targets and AP fin-stabilised discarding sabot (APFSDS) and general purpose rounds-airburst (GPR-AB) for use against ground targets, and another 40 inside the vehicle. One to ten AA-AB rounds would be a typical burst against aerial targets. The gun is effective against aerial targets out to 4,000m and 2,500m against IFVs and APCs. The RapidFire would typically be linked to a Thales ControlMaster 200 or ControlMaster 60 C2, which are based on the GroundMaster radar family. The ControlMaster 60 is able to detect targets at ranges beyond 40km and can coordinate up to six RapidFire systems. The RapidFire is equipped with a gyro-stabilised sensor head, equipped with IR and day sensors, and a laser rangefinder, enabling it to engage targets without being linked to a ControlMaster. The RapidFire is operated by a crew of two. Additional protection can be fitted to improve survivability. **Calibre:** 40mm **Effective range:** 4,000m against aerial targets, 2,500m against AFVs **Rate of fire:** up to 200rpm **Ammunition:** AA-AB, APFSDS, GPR-AB

Zakłady Mechaniczne Tarnów ▸ ZSU-23-4MP Biala

The ZSU-23-4 Shilka tracked SP four-barrel 23mm anti-aircraft gun was developed in 1957-65 by Mytishchi Engineering Works to meet the requirement of the Soviet Army for a SPAAG to protect its armoured formations. An estimated 6,500 systems were built before production ended in 1982 and many of these systems remain operational in more than 35 countries, including Egypt, India, former Soviet client states and former states of the USSR. Since 2005, Polish land forces have operated the ZSU-23-4MP Biala, a locally developed upgrade of the Shilka and ZMT continues to market the system. The Biala has numerous improvements, including the installation on the back of the turret of four launchers for the MESKO PZR Grom MANPADS missile and a new digital FCS. With a rate of 400rpm for each gun, the four water-cooled AZP-23 23mm cannon can engage targets to a maximum range of 3,000m, depending on the ammunition used, while the PZR Grom can engage targets at ranges from between 400 and 5,500m and altitudes from 30-11,500ft. The Biala's radar can detect targets at a maximum range of 8-10km and track targets at a range of 7-8km. The upgrade has reduced the crew size from four to three. As well as low-flying aircraft, helicopters, UAVs and rockets, the Biala engage unarmoured and lightly armoured ground targets. **Length:** 6.54m **Calibre:** 4x 23mm AZP-23 cannon **Effective range:** 2,000m for API and HEI, 3,000m for APDS and FAPDS **Elevation:** -4/+85° **Traverse:** 360° **Rate of fire:** 400rpm **Ammunition:** APDS, API, FAPDS, HEI

SPECIFICATIONS

TOWED AND STATIC AIR DEFENCE GUNS

This section provides a guide to static and towed air defence gun systems that are under development, in production or being substantially modernised.

The specifications listed here are intended to provide a handy reference source for the basic parameters that describe the weapon's performance. Most data has been supplied by the manufacturers, who can give more detailed information on request. Contact details are listed in the supplier guide.

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Soldiers with the Ukrainian army's 1st Battalion, 95th Separate Airmobile Brigade, fire a ZU-23 twin-barreled 23mm anti-aircraft gun during training at the Yavoriv Combat Training Center. (Photo: US Army)

Leonardo Defence Systems ▸ Porcupine

The Porcupine system was developed to meet the Italian Army's C-RAM requirement. Each remote firing unit consists of a 20mm M61A1 six-barrel Gatling cannon, its ammunition handling system and a stabilised optronic IR tracking system to provide a 24hr target engagement capability. One Porcupine C-RAM system would typically cover an area of 400x400m. A typical configuration would consist of four firing units, one central control post for target designation and weapon control, and a 3D radar system for surveillance and target tracking. Leonardo has developed the system's IR system and radar. The system provides a simultaneous multi-engagement capability as each gun is able to engage a different target. **Calibre:** 20x108mm **Effective range:** up to 10km **Elevation:** +80/-10° **Traverse:** 360° **Rate of fire:** 3,000-6,000rpm

Norinco ▸ Type 80

Norinco markets its twin-barrel towed Type 80 anti-aircraft gun as a component of its Giant Bow II SHORAD system, which also includes TY-90 missile launchers, the Giant Bow II battery command vehicle (BCV) and the AS901A 3D target designation radar. The gas-operated Type 80 is equipped with both an EO sight and a reliable vector sight. It can operate in BCV-controlled fully automatic mode, gun EO sight directed semi-automatic mode, and gun vector sight manual mode. The gun fires HE incendiary-tracer and AP incendiary-tracer ammunition. The gun mount is electrically powered with manual controls for emergency use. The gun is operated by a crew of five, three of whom serve as ammunition carriers and loaders. Giant Bow II can be deployed in a gun-only configuration or a gun and missile integrated combination. In 'concentration fire mode' three guns and two TY-90s are deployed within 100m of the BCV. **Muzzle velocity:** 970m/s **Calibre:** 23mm **Effective range:** 7,000m **Elevation:** -10/90° **Traverse:** 360° **Crew:** 5 **Rate of fire:** 2,000rpm **Ammunition:** 50-round belts of HEI-T or API-T **Mount weight:** 950kg **Mount length:** 4.6m in travelling configuration **Mount width:** 1.8m in travelling configuration **Mount height:** 1.9m in travelling configuration

PIT-Radwar ▸ Hydra

At MSPO 2016 in Poland, PIT-Radwar exhibited a prototype of the remote-controlled Hydra 35mm anti-aircraft gun developed for the Notec project to replace the Polish Navy's S-60MB 57mm guns, used to protect shore installations. PIT-Radwar has developed two towed Hydra variants, both using a licensed Oerlikon KDA 35mm cannon and mounted on a four-wheel carriage equipped with two stabilisers which are lowered before firing. Each version is equipped with a GPS/INS system. A dual-feed arrangement, with a 100-round ammunition box mounted on each side of the weapon, enables fast switching between two different types of ammunition such as frangible armour-piercing discarding sabot and air burst munition (ABM). The AG-35 variant, displayed at the show, has an optoelectronic target acquisition and sighting system, developed by PIT-Radwar in cooperation with WAT, equipped with TV cameras, IR sensors and two laser rangefinders. The AG-35's sensor package enables the weapon to operate autonomously. The A-35 variant is equipped with a Prexer CP-1-35 sight and uses programmable 35x228 mm ammunition, designed by Mesko. The A-35 works in conjunction with the WG-35 fire control vehicle which is able to control up to eight guns. The WG-35 is based on the AMZ-Kutno Zubr-P 4x4 armoured vehicle, which is also used in PIT-Radwar's Poprad self-propelled VSHORAD missile system (see separate entry). The WG-35 is equipped with optoelectronic sensor equipped with TV and thermal cameras, IFF and a laser rangefinder. A tracking radar can also be mounted on the WG-35. The Hydra can engage aircraft, helicopters and UAVs at ranges up to 6,000m and altitudes up to 11,500ft. Using ABM, the Hydra can assist in defeating rocket, artillery and missile targets at ranges up to 3,000m. It can also be used against ground and naval targets. The navy is expected to order 24 guns in the 2019-22 period. **Calibre:** 35x228mm **Effective range:** 6,000m against aircraft, 3,000m against RAM and missile targets **Elevation:** -5/85° **Traverse:** 360° **Rate of fire:** 550rpm **Ammunition:** 2x 100 round boxes

Raytheon ▸ Centurion LPWS

Raytheon developed the Centurion Land-based Phalanx Weapon System (LPWS) in 2004-05 to provide a C-RAM system to protect US bases in Iraq. The heart of the Centurion is Raytheon's Phalanx (MK15) 1B 20mm Close-In Weapon System, used by the US and numerous other navies, for the land-based C-RAM role. The system's M61A1 six-barrel Gatling gun fires 3,000 or 4,500rpm. The Phalanx fires 20mm HE incendiary tracer, self-destruct ammunition for the C-RAM role. These rounds explode on impact with the target or on tracer burnout to reduce the risk of collateral damage. The gun and sensor packages – a Ku-band search radar, a Ku-band track radar and a FLIR with automatic acquisition tracker – are mounted on a low-loader truck/trailer. In 2008, Raytheon teamed with Oshkosh to offer the Centurion integrated on a 13t Oshkosh 8x8 Heavy Expanded Mobility Tactical Truck to improve the system's mobility. US Army air defence artillery units are trained to operate the Centurion before deployment, but in 2013 the service formed its first indirect fire protection capability (a new term incorporating the C-RAM role) battalion. In late 2014, the UK MoD awarded a $30.3 million contract with Babcock to provide Phalanx Block 1B CIWS upgrade kits and return the UK's four LPWSs to their original naval configuration. **Calibre:** 20x102mm **Rate of fire:** 3,000 or 4,500rpm **Ammunition:** 1,500 rounds of ready ammunition **Mount weight:** 24t on trailer

PRODUCTS

GUIDE TO SUPPLIERS

Key companies supplying goods, services and equipment to the artillery and air defence industry worldwide, separated into two listings – by product then by supplier.

Products are ordered alphabetically with suppliers and their location under each. Listings from p119 are organised alphabetically by company and include:

- company address
- email and website addresses
- telephone and fax numbers
- contact names

Highlighted entries also include the company's logo and a summary of activity.

To update a listing or submit new information, email Karima Thibou at karima.t@shephardmedia.com

ABOVE: A gun crew from Battery B, 2nd Battalion, 8th Field Artillery Regiment, loads a 155mm howitzer round in the Yukon Training Area, Alaska. (Photo: US Army)

PRODUCTS

Air defence radars
Aselsan (TURKEY)
Avibras Indústria Aeroespacial (BRAZIL)
BAE Systems (UK)
BATS Belgian Advanced Technology Systems (BELGIUM)
BelTechExport (BELARUS)
Bharat Electronics (INDIA)
China Aerospace Science and Industry Corporation (CASIC) (CHINA)
ECRIEE – East China Research Institute of Electronic Engineering (CHINA)
IAI ELTA Systems (ISRAEL)
LEMZ (RUSSIA)
Leonardo (ITALY)
Mitsubishi Electric (JAPAN)
National Chung-Shan Institute of Science and Technology (TAIWAN)
Northrop Grumman UK (UK)
RADA Electronic Industries (ISRAEL)
Raytheon Missile Systems (USA)
Raytheon UK (UK)
Rheinmetall (GERMANY)
Saab (SWEDEN)
Tetraedr (BELARUS)
Thales (FRANCE)
ThalesRaytheonSystems (FRANCE)
V Tikhomirov NIIP (RUSSIA)

Missiles – surface-to-air
Almaz-Antey (RUSSIA)
BelTechExport (BELARUS)
CEIEC – China National Electronics Import & Export (CHINA)
Diehl Defence (GERMANY)
EdePro (Engine Development and Production) (SERBIA)
EUROSAM (FRANCE)
IAI MLM Division (ISRAEL)
IMI Rocket Systems Division (RSD) (ISRAEL)
KBM (RUSSIA)
LIG Nex1 (SOUTH KOREA)
MBDA (FRANCE)
MEADS International (USA)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon (USA)
Romarm (ROMANIA)
Saab (SWEDEN)
Tetraedr (BELARUS)
Thales (FRANCE)
Ulyanovsk Mechanical Plant (RUSSIA)
V Tikhomirov NIIP (RUSSIA)

Self-propelled air defence
Almaz-Antey (RUSSIA)
Aselsan (TURKEY)
Boeing Defense, Space & Security (USA)
Diehl Defence (GERMANY)
EUROSAM (FRANCE)
KBP Instrument Design Bureau (RUSSIA)
MBDA (FRANCE)
Norinco (CHINA)
PIT-Radwar (POLAND)
Rafael Advanced Defense Systems (ISRAEL)
Raytheon (USA)
Rheinmetall Air Defence (SWITZERLAND)
Thales (FRANCE)
Ulyanovsk Mechanical Plant (RUSSIA)

Self-propelled artillery
Avibras Indústria Aeroespacial (BRAZIL)
BAE Systems Platforms & Services (USA)
CIO Consorzio Iveco-Oto Melara (ITALY)
Combat Vehicles Research and Development Establishment (INDIA)
Denel Land Systems (SOUTH AFRICA)
Elbit Systems Land and C4I (ISRAEL)
Excalibur Army (CZECH REPUBLIC)
EXPAL (SPAIN)
Hanwha Techwin (SOUTH KOREA)
HSW- Huta Stalowa Wola (POLAND)
IMI Systems (ISRAEL)
Kongsberg Defence & Aerospace (NORWAY)
Krauss-Maffei Wegmann (GERMANY)
Lockheed Martin Missiles and Fire Control (USA)
Mandus Group (USA)
Military Industrial Corporation (MIC) (SUDAN)
MKEK (TURKEY)
Motovilikhinskiye zavody (RUSSIA)
Norinco (CHINA)
Patria Land (FINLAND)
Poly Technologies (CHINA)
Rheinmetall Landsysteme GmbH (GERMANY)
Roketsan (TURKEY)
RUAG Defence (SWITZERLAND)
Singapore Technologies Kinetics (ST Kinetics) (SINGAPORE)
TDA Armements (FRANCE)
UralVagonZavod (RUSSIA)

Tracked vehicles
Anniston Army Depot (USA)
BAE Systems (UK)
BAE Systems Bofors (SWEDEN)
BUMAR Łabędy (POLAND)
China Xinshidai Co (CHINA)
CIO Consorzio Iveco-Oto Melara (ITALY)
Defence Research & Development Organisation (INDIA)
General Dynamics UK (UK)
Hanwha Techwin (SOUTH KOREA)
Heavy Industries Taxila (PAKISTAN)
HSW- Huta Stalowa Wola (POLAND)
Hyundai Rotem (SOUTH KOREA)
Israel Defense Forces (ISRAEL)
Kharkiv Morozov Machine Building Design Bureau (UKRAINE)
Kurganmashzavod (RUSSIA)
Minotor-Service (BELARUS)
Mitsubishi Heavy Industries (JAPAN)
Motovilikhinskiye zavody (RUSSIA)
Nexter Systems (FRANCE)
Norinco (CHINA)
OBRUM (POLAND)
Ordnance Factory Board (INDIA)
PSM Projekt System & Management (GERMANY)
R-PAD Technology (UK)
Rheinmetall Landsysteme GmbH (GERMANY)
Romarm (ROMANIA)
RUAG Defence (SWITZERLAND)
Sabiex International (BELGIUM)
Singapore Technologies Kinetics (ST Kinetics) (SINGAPORE)
Ukrspecexport (UKRAINE)
UralVagonZavod (RUSSIA)
Đuro Đaković Specijalna vozila (CROATIA)

Turrets
Cook Defence Systems (UK)
Excalibur Army (CZECH REPUBLIC)
FNH UK (UK)
General Dynamics UK (UK)
Hanwha Defense (SOUTH KOREA)
Hensoldt Optronics (Pty) Ltd (SOUTH AFRICA)
Kintex (BULGARIA)
Kurganmashzavod (RUSSIA)
Moog Components Group (USA)
Nexter Systems (FRANCE)
Rafael Advanced Defense Systems (ISRAEL)
Rheinmetall Landsysteme GmbH (GERMANY)
Romarm (ROMANIA)
Singapore Technologies Kinetics (ST Kinetics) (SINGAPORE)
Textron Systems Marine & Land Systems (USA)

Weapons – ammunition
Australian Munitions (AUSTRALIA)
BAE Systems Platforms & Services (USA)
BUMAR Łabędy (POLAND)
Burkan Munitions Systems (UAE)
CBC (BRAZIL)
China Xinshidai Co (CHINA)
CMI Defence (BELGIUM)
Cyalume Technologies Inc (USA)
Cyalume Technologies SAS (FRANCE)
D Dupleks (LATVIA)
Daniel Technologies (IRELAND)
Day & Zimmermann (USA)
Defense Industries Organization (IRAN)
Denel Dynamics (SOUTH AFRICA)
Denel Land Systems (SOUTH AFRICA)
Diehl Defence (GERMANY)
Diehl Defence Land Systems (GERMANY)
Excalibur Army (CZECH REPUBLIC)
EXPAL (SPAIN)
FN Herstal (BELGIUM)
FNH UK (UK)
Garwood Industries (USA)
General Dynamics European Land Systems – Steyr (AUSTRIA)
General Dynamics Ordnance and Tactical Systems (USA)
Heavy Industries Taxila (PAKISTAN)
Hellenic Defence Systems (EBO-PYRKAL) (GREECE)
Hirtenberger Defence Systems (AUSTRIA)
IMI Systems (ISRAEL)
International Golden Group (UAE)
Kalashnikov Concern (RUSSIA)
KBP Instrument Design Bureau (RUSSIA)
Kintex (BULGARIA)
Konštrukta – Defence (SLOVAKIA)
Kurganmashzavod (RUSSIA)
Lacroix (FRANCE)
Marvin Land Systems (USA)

MESKO (POLAND)
MKEK (TURKEY)
MLM International (USA)
Moog Components Group (USA)
Motovilikhinskiye zavody (RUSSIA)
Nammo (NORWAY)
Nammo Lapua (FINLAND)
Nexter Systems (FRANCE)
Norinco (CHINA)
Orbital ATK (USA)
Orbital ATK Armament Systems (USA)
Orbital ATK Defense Systems Group (USA)
Ordnance Factory Board (INDIA)
Pakistan Ordnance Factories (PAKISTAN)
Poongsan (SOUTH KOREA)
Rafael Advanced Defense Systems (ISRAEL)
Rheinmetall (GERMANY)
Rheinmetall Denel Munition (SOUTH AFRICA)
Rheinmetall Waffe Munition Arges (AUSTRIA)
Romarm (ROMANIA)
Romtehnica (ROMANIA)
Rosoboronexport (RUSSIA)
RUAG Ammotec (SWITZERLAND)
Singapore Technologies Kinetics (ST Kinetics) (SINGAPORE)
SM Group (INDIA)
SME Ordnance (MALAYSIA)
SO SIA 'Fort' (UKRAINE)
TAR Ideal Concepts (ISRAEL)
Thales Australia (AUSTRALIA)
The Beta Company (USA)
Ukrspecexport (UKRAINE)
Umarex (GERMANY)
Yugoimport-SDPR J.P (SERBIA)

Weapons – mortars

Agencija Alan (CROATIA)
Denel Land Systems (SOUTH AFRICA)
Elbit Systems Land and C4I (ISRAEL)
EXPAL (SPAIN)
FNSS Savunma Sistemleri (TURKEY)
Gun Carriage Factory (INDIA)
Hellenic Defence Systems (EBO-PYRKAL) (GREECE)
Hirtenberger Defence Systems (AUSTRIA)
Hyundai WIA (SOUTH KOREA)
IMI Systems (ISRAEL)
King Abdullah II Design and Development Bureau (JORDAN)
MKEK (TURKEY)
Norinco (CHINA)
Ordnance Factory Board (INDIA)
Rosoboronexport (RUSSIA)
RUAG Defence (SWITZERLAND)
Singapore Technologies Kinetics (ST Kinetics) (SINGAPORE)
TAR Ideal Concepts (ISRAEL)
TBR – Tehnični biro Ravne (SLOVENIA)

Weapon-mounted fire control

Advanced Defense Systems, Inc (ADS) (USA)
Singapore Technologies Kinetics (ST Kinetics) (SINGAPORE)

Weapons – rockets/ launchers

Advanced Defense Systems, Inc (ADS) (USA)
Agencija Alan (CROATIA)
BelTechExport (BELARUS)
BrahMos Aerospace (INDIA)
China Aerospace Long-March International (CHINA)
Defense Industries Organization (IRAN)
EdePro (Engine Development and Production) (SERBIA)
Emirates Defense Technology (UAE)
IMI Rocket Systems Division (RSD) (ISRAEL)
IMI Systems (ISRAEL)
KBP Instrument Design Bureau (RUSSIA)
LIG Nex1 (SOUTH KOREA)
MKEK (TURKEY)
Nammo (NORWAY)
Orbital ATK (USA)
Ordnance Factory Board (INDIA)
Pakistan Ordnance Factories (PAKISTAN)
Romarm (ROMANIA)
Rosoboronexport (RUSSIA)
Roxel (FRANCE)
SpaceX (USA)
TAR Ideal Concepts (ISRAEL)
Ukrspecexport (UKRAINE)
Wojskowe Zakłady Uzbrojenia (POLAND)
Yugoimport-SDPR J.P (SERBIA)

Weapons

Artillery Plant No.9 (RUSSIA)
Excalibur Army (CZECH REPUBLIC)
IMI Systems (ISRAEL)
KBP Instrument Design Bureau (RUSSIA)
Konštrukta – Defence (SLOVAKIA)
MESKO (POLAND)
Motovilikhinskiye zavody (RUSSIA)
Nammo (NORWAY)
Norinco (CHINA)
Orbital ATK (USA)
Rafael Advanced Defense Systems (ISRAEL)
Romarm (ROMANIA)
Romtehnica (ROMANIA)
Rosoboronexport (RUSSIA)
Ukrspecexport (UKRAINE)

Wheeled vehicles (4x)

BAE Systems Inc (USA)
BAE Systems Platforms & Services (USA)
China Xinshidai Co (CHINA)
Excalibur Army (CZECH REPUBLIC)
IMI Systems (ISRAEL)
KIA Motors (SOUTH KOREA)
Nexter Systems (FRANCE)
Romarm (ROMANIA)
Romtehnica (ROMANIA)
Rosoboronexport (RUSSIA)
Singapore Technologies Kinetics (ST Kinetics) (SINGAPORE)
Ukrspecexport (UKRAINE)

Wheeled vehicles (6x)

BAE Systems Inc (USA)
Nexter Systems (FRANCE)
Romarm (ROMANIA)
Romtehnica (ROMANIA)
Ukrspecexport (UKRAINE)

Wheeled vehicles (8x)

Denel Vehicle Systems (SOUTH AFRICA)
Nexter Systems (FRANCE)
Romarm (ROMANIA)
Romtehnica (ROMANIA)
Singapore Technologies Kinetics (ST Kinetics) (SINGAPORE)
Ukrspecexport (UKRAINE)

ABOVE: Soldiers fire an M777 howitzer during *Dynamic Front 18* at the Grafenwoehr Training Area, Germany. (Photo: US Army)

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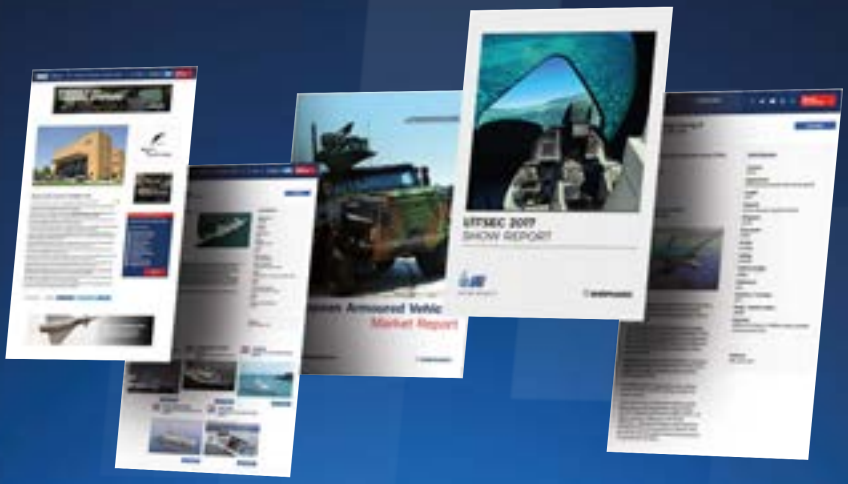

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